

Katuki (*Picrorhiza Kurroa* Royle Ex Benth.): A Comprehensive Review of Its Ayurvedic Significance, Phytochemistry, Pharmacological Potential, and Conservation

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Abstract- Katuki (*Picrorhiza kurroa* Royle ex Benth.) is an important Himalayan medicinal herb, famous in Ayurveda for its bitter taste and traditional uses in diseases related to liver, gastrointestinal tract, skin and metabolic processes. It belongs to family Plantaginaceae and is mainly associated with the high altitude habitats of the Himalayan region. The medicinal importance of this plant has attracted significant scientific interest, especially due to the presence of iridoid glycosides picroside-I and picroside-II which are among the major bioactive constituents of this plant. Other phytochemical groups reported include cucurbitacins, phenolic compounds, flavonoids and associated secondary metabolites. The present review is aimed to critically review the ayurvedic importance, botanical identity, phytochemical composition, pharmacological activities, safety issues and conservation challenges of *P. kurroa*. The literature on its traditional uses, experimental pharmacology, clinical research, phytochemical standardization, cultivation and conservation has been reviewed. Recent studies have reported hepatoprotective, antioxidant, anti-inflammatory, immunomodulatory, antimicrobial and many other biological activities. However, the strength of evidence is highly variable between indications and data from laboratory and animal studies cannot be extrapolated directly to clinical efficacy in humans. It is more difficult to compare because of differences in plant authentication, extraction procedures, chemical composition, and study design.

Keywords- Ayurveda, Dravyaguna, Katuki, *Picrorhiza kurroa*, phytochemistry.

Introduction-

Ayurveda holds this distinction as the “oldest medical system known to man and the oldest and most comprehensive spiritual teachings in the world. The basis of Ayurveda is the idea that a person can increase their lifespan by maintaining balance between their body, mind and spirit.¹ Modern science uses harsh chemical substances. Ayurveda uses natural therapeutic compounds which are safer for human body. Ayurveda doesn't follow a “offensive strategy,” rather it works on enhancing the host body's capacity to resist a number of physical and psychological stress. Ayurveda is interested in eating, breathing, digestion, thoughts, memory and sleep to understand the root causes of disease. These are easy ways to improve your health².

Medicinal plants have been the backbone of traditional health care systems and are still important sources for the discovery of pharmacologically active natural products. Ayurveda is one of the established traditional medical systems of India. It has described many medicinal plants in terms of their Rasa (taste), Guna (qualities), Virya (potency), Vipaka (post-digestive effect) and Prabhava (specific action). These concepts provide a traditional basis for the understanding of the therapeutic use of plant-derived substances. *Picrorhiza kurroa* Royal ex Benth, Kutki (*P. kurroa*) is an important medicinal plant which is recommended and used in Ayurveda traditionally for thousands of years with some precautions. In the last few decades

we have seen a remarkable resurgence of interest in its pharmacology, pharmacognosy and phytochemistry. Kutki is a small perennial herb and fast decaying high value medicinal plant growing in the north-western Himalayan region of India, Pakistan and hilly parts of Nepal.³ Katuki (*Picrorhiza kurroa* Royle ex Benth) is a medicinal herb of special importance in the Ayurvedic materia medica. Kutki or Kutaki is known widely and is related to bitter tasting medicinal drugs traditionally used in hepatic and gastrointestinal disorders. Recent research has focussed on the iridoid glycosides in particular, and their possible contribution to biological activities.

The pharmacological interest in Katuki is particularly evident from the studies targeting hepatoprotective, antioxidant, anti-inflammatory and immunomodulatory effects. Reviews published in recent years describe a diverse range of chemical constituents and experimental activities while also pointing toward the need for better clinical validation, chemical characterization and conservation. Although Katuki is medicinally important its continued availability is a concern. The plant is associated with high altitude Himalayan ecosystems, and harvesting of its roots and rhizomes can damage or destroy individual plants. Natural populations may be stressed by slow growth, habitat disturbance and commercial demand.

Therefore a comprehensive review is required to combine classical Ayurvedic knowledge, with the botanical identity, with phytochemistry, pharmacological evidences, safety considerations and conservation strategies. Such an integrated approach may help identify the research gaps and set priorities for the scientifically responsible use of Katuki.⁴

Scientific Classification:⁵

Taxonomic Rank	Classification
Kingdom	Plantae
Division	Tracheophytes
Clade	Angiosperms
Clade	Monocots
Order	Lamiales
Old Family	Scrophulariaceae
New Family	Plantaginaceae
Genus	<i>Picrorhiza</i>
Species	<i>Picrorhiza kurroa</i>
Scientific Name	<i>Picrorhiza kurroa</i> Royle ex Benth.

Habit: A hairy herb with perennial bitter root stock leaves – 5-10cm, rather coriaceous, tip rounded base narrowed into a winged sheathing petiole.

Habitat: It is an indigenous plant of western Himalayan at 3000-5000 m of elevation⁶. Western Himalayan range includes Jammu and Kashmir, Himachal Pradesh and Uttarakhand. In Kashmir, it is mainly found in Gurez, Lolab, Karna, Sindh and Lidder Valleys. In Uttarakhand it is found in areas of Badrinath, Kedarnath and Chamba. In Himachal Pradesh it is wildly found in hilly districts such as Chamba, Pangi, Kullu, Shimla, Kinnaur and Lahaul valleys⁷.

Botanical characteristic features:⁸ Small perennial herb Height 10-20 cm Stem Small, leafy, weak, creeping; erect at flowering Roots 6-10 inches long, hard, wrinkled, greyish to brown Rhizomes 2.5–12.0 cm long, 0.3–1.0 cm thick, cylindrical, irregularly curved, jointed nodes with branching and rooting Rhizome Appearance Externally greyish-brown Aerenchyma Presence Found in leaves, aerial stem, and rhizome Leaves Basal, alternate, 5-15 cm long, oval, acuminate, serrate, stalked, winged, oblanceolate/narrowly spatulate, coarsely toothed, Leaf Hairs Two types of glandular hairs present, Flowers White or pale purple, bisexual, on long terminal spikes Calyx 5 equal parts Corolla 4-5 lobed, actinomorphic Stamens 4, slightly didynamous, inserted on corolla tube Stigma Capitulate, Fruits/Capsules Acute, ovoid, swollen, 6-10 mm, tapered at the top, splits into 4 valves, Seeds Numerous, pale brown, 1 x 0.8 mm, ellipsoid, thick transparent seed coat.

Flowering and fruiting :

Flowering and fruiting occur between October - December.



Plant of Kutaki



Root of Kutaki

Chemical Composition-

Phytochemistry is one of the most thoroughly studied features of *P. kurroa*. More than 50-65 secondary metabolites have been found in different research depending on the plant material, extraction process and analytical approach. The chemical classes reported include iridoid glycosides, phenolics, cucurbitacins, terpenoids and other compounds.

Active principles: D- mannitol, Kukiol, Kutkisterol, apocyanin, phenol glucosides, androsin, picrin iridoid, glycosides, kutkin, picroside I and picroside II, and III, kutkoside, minecoside, picrorhizin, arvenin IV etc. ⁹

Major phytoconstituents:-

A. Iridoid glycosides

The most extensively investigated constituents include:

Picroside-I, Picroside-II, Picroside-III, Picroside-IV, Picroside-V, Kutkoside, Pikuroside, Catalpol-related compounds, other iridoid glycosides.

B. Phenolic compounds

Reported phenolic constituents include:

Apocynin, Vanillic acid, Ferulic acid, Cinnamic acid, Related phenolic compounds.

C. Cucurbitacins

Cucurbitacin-type compounds have also been isolated from *P. kurroa*. These compounds have attracted interest because of their anti-inflammatory and cytotoxic/anticancer activities in experimental models.

D. Other constituents

Other reported constituents include:

D-mannitol, terpenoids, fatty acids, aromatic esters, phenylethanoid-related compounds.

Picrosides as Chemical Markers

Picroside-I and picroside-II are particularly important in the standardization of Kutaki preparations. High-performance liquid chromatography (HPLC) has been used for quantitative determination of picrosides. An earlier experimental and clinical investigation standardized a *P. kurroa* preparation based on picroside-I and picroside-II content.

Chemical characteristics analysis-¹⁰

In Indian Herbal Pharmacopoeia, the quality control parameter for dry “Kutki” (*Picrorhiza kurroa*) powder are mentioned as foreign matter should not be more than 2%, total ash should not be more than 7% and acid-insoluble ash should not be more than 1%. Also, alcohol soluble extractives should not be less than 20% and water-soluble extractives should not be less than 30%.

Ayurvedic Properties-¹¹

Properties	Katuki
<i>Picrorrhiza kurroa royle ex benth.</i>	
Family	Scrophulariaceae
Rasa	Tikta, Katu
Guna	Ruksha, laghu
Veerya	Ushna
Vipaka	Katu
Dosa Karma	Vaat-pitta Shamaka
Karma	Bhedaniya, Prajasthapan, pitta shamaka

Medicinal properties of Kutaki *Picrorhiza kurroa*-¹²⁻¹⁸

It is a significant herb in the Ayurvedic medicinal system of India. Hepatoprotective, antioxidant, anti-inflammatory, immunomodulatory, antiallergic, antiasthmatic, anticancerous, cardiovascular, choleric, hypoglycemic, hypolipidemic, antiviral, purgative, anti-phosphodiesterase, neuritogenic, molluscicidal, and leishmanicidal properties have all been discovered. Asthma, bronchitis, malaria, chronic diarrhea, viral hepatitis, upset stomach, scorpion bite, bitter tonic (which increases appetite and improves digestion), and liver protection have all historically been treated using its subsurface portion. Additionally, it has been used to treat rheumatic arthritis, vitiligo, neuralgia, peptic ulcers, and skin disorders. Its rhizome and root extracts have recently been demonstrated to have anti-malarial properties. In India, *Picrorhiza kurroa* is used in a number of commercially accessible medication formulations that contain P-I and P-II in varying amounts.

Part used: Root

Formulations: Astavarga churna, Chyavanprash rasayan, Chitrakadi taila, Vachadi taila, Mahakalyan ghrita, Mahamayura ghrita, Mahapadma taila, Jivaniya ghrita, Vajikaran ghrita, Brahini gutika and Himvana agada.

Substitutes: Guruchi (*Tinospora cordifolia* (Willd.) Miers), Safed behmen (*Centaurea behen* Linn.), and Vidari kand (*Pueraria tuberosa* (Willd.) DC). In substitute of Jeevak, two species of *Malaxis* found in the North-West Himalaya (Uttarakhand) are *Malaxis cylindrostachya* (Lindl.) Kuntze and *Malaxis mackinnoni* (Duthie) Ames.^{19,20}

Phytochemistry of *P. kurroa* -

Many physiologically active compounds have been extracted from its rhizomes, roots, seeds, stems, and leaves as a result of extensive research into its chemical characteristics. Over 65 secondary metabolites have been produced by this plant. A crystalline substance called "Picroliv" or "Kutkin," which is made up of two C9-IGs (C9-Iridoid Glycosides) known as kutkoside, is produced by the rhizomes and roots of *P. kurroa*. The ratio of Picroside-I to Picroside-II is 2:1.²¹

The IGs (Iridoid Glycosides) Picrosides I, II, and III, cucurbitacins, and kutkoside were discovered in *P. kurroa* rhizomes using HPLC (high-performance liquid chromatography) techniques.²²

Many bioactive substances with pharmacological and medicinal potential are found in *P. kurroa*, including as glycosides, iridoids, alkaloids, phenolics, terpenes, and cucurbitacins.²³

Picrorhiza has cholagogue, digestive, and appetizing properties in addition to its purgative and emaciating properties. It also stimulates the heart and liver. Picroside and kutkoside are combined to form kutkin, the active component of *P. kurroa*. Kutkin (picrosides and kutkosides) has shown hepatoprotective properties

pharmacologically. Drosin and apocynin are two other bioactive substances that were extracted from this plant. Apocynin is one catechol that may prevent neutrophils from responding oxidatively²⁴.

The well-known cytotoxic and anti-tumorous properties of cucurbitacins B, D, and R are found in *P. kurroa*. In addition to having anti-inflammatory and antioxidant properties, apocynin is a potent NADPH (nicotinamide adenine dinucleotide phosphate) oxidase inhibitor. Androsin has the ability to prevent asthma²⁵.

LC ESI-MS/MS (liquid chromatography–electrospray ionization/multi-stage mass spectrometry) methods have also revealed the presence of flavonoids such as apocynin and vanillic acid, kutokoside, pikurosides, and picrosides I, II, III, and IV in the 70 % hydroalcoholic fraction.²⁶

Pharmacological Potential of Kutaki (*P. kurroa*)-

Hepatoprotective activity - A traditional experimental/clinical investigation examined the use of *P. kurroa* in acute viral hepatitis and found that it has hepatoprotective properties in an animal model. Standardized root powder was employed in the clinical investigation, which found that the treatment and placebo groups had different bilirubin and transaminase-related results. However, because the research was small, its historical design should be taken into account while analyzing the data. In comparison to hepatoprotective substances like catapol, silymarin, and rographolide, picroliv, which was derived from *P. kurroa*, has been evaluated for its effects against ethanol-induced toxicity in rats. The findings indicated a minimal hepatoprotective effect, as evidenced by the reduced levels of marker enzymes such as alkaline phosphatase, glutamic-oxaloacetic transaminase, glutamic pyruvic transaminase, and aldehyde dehydrogenase²⁷. A methanol extract derived from the rhizomes of *Picrorhizakurroa* Royle ex Benth. (Plantaginaceae) showed hepatoprotective properties against liver damage in mice induced by D-galactosamine (D-GalN)/lipopolysaccharide (LPS)²⁸.

Antioxidant Activity- In an effort to find a novel natural source of antioxidants, Kant et al. (2013) studied the antioxidant capacity of *P. kurroa* leaves. DPPH and ABTS tests were used to assess the antioxidant properties of many solvent extracts, such as ethanol, butanol, and ethyl acetate, as well as an isolated chemical, luteolin-5-O-glucopyranoside. According to the findings, luteolin-5-O-glucopyranoside had an IC₅₀ value similar to that of regular ascorbic acid, suggesting that *P. kurroa* leaves might be a natural source of antioxidants.²⁹

Anti-inflammatory Activity-

Extracts and components from *P. kurroa* have been shown in experiments to have anti-inflammatory properties. Modulation of inflammatory mediators and transcriptional pathways like NF- κ B are among the suggested strategies. Among the substances examined for these effects include phenolic components and iridoid glycosides. Anti-inflammatory effect in experimental models has been reported in reviews; nevertheless, further compound-specific mechanistic study is needed. PKRE, a hydroalcoholic extract of *P. kurroa* rhizome, was discovered by Rohit Kumar et al. (2016) to have anti-inflammatory properties by reducing granuloma formation, paw edema, and proinflammatory mediator production in macrophages. This was accomplished by blocking the iNOS and NF- κ B signaling pathway.³⁰

Anti-asthmatic-

Studies have shown that androsin, a constituent of *P. kurroa*, significantly reduced allergen-induced bronchial obstruction in guinea pigs. The plant extract also inhibited histamine release in vitro³¹.

Anti-diabetic-

Research has found that *P. kurroa* extract reduces serum lipid peroxide levels and blood urea nitrogen in diabetic rats induced by alloxan, while also inhibiting weight loss and leukopenia. This suggests that *P. kurroa* extracts may mitigate metabolic damage caused by alloxan³².

Anti-cancer-

A study investigated the antineoplastic and antioxidant properties of methanolic extracts and aqueous extracts of *P. kurroa* rhizomes. The extracts were tested for their cytotoxic effects on human breast carcinoma, human hepatocellular carcinoma, and human prostate cancer cell lines using the XTT assay.

The results demonstrated that both extracts exhibited significant antineoplastic activity by inducing apoptosis in all three cancer cell lines, suggesting their potential as natural anticancer agents ³³.

Immunomodulatory Activity-

Several *P. kurroa* extracts have been shown to exhibit immunomodulatory activity. Experimental investigations have revealed alterations in cellular immune responses, humoral responses, phagocytic activity, and reticuloendothelial function. These results point to possible immunological activity, but the translation of experimental immunomodulation into particular human therapeutic indications is still not well established.³⁴

Antimicrobial Activity-

In lab tests, *P. kurroa* extracts have shown antibacterial action against a number of Gram-positive and Gram-negative pathogens. The following organisms have been reported to be active: *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Escherichia coli*, and *Staphylococcus aureus*

However, there are significant differences in extract composition, concentration, and experimental design between research, making it difficult to compare results directly.

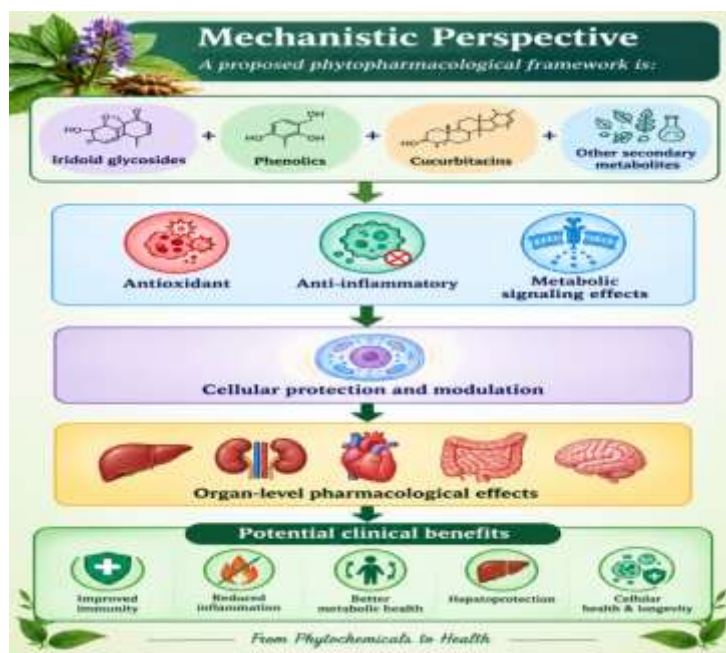
Other Pharmacological Activities-³⁵

Pharmacological activity	Evidence status
Hepatoprotective	Stronger preclinical + limited clinical evidence
Antioxidant	Mainly experimental
Anti-inflammatory	Mainly experimental
Immunomodulatory	Mainly experimental
Antidiabetic	Mainly experimental
Antimicrobial	Mainly in-vitro
Anticancer	Mainly preclinical
Anti-ulcer/intestinal	Experimental
Antiasthmatic	Experimental/traditional
Antifibrotic	Experimental
Hypolipidemic	Experimental

Integrated Evidence Table³⁶

Activity	Evidence type	Principal evidence	Current interpretation
Hepatoprotective	Animal + limited human	Galactosamine model + small RCT	Promising but clinical evidence limited
Antioxidant	In-vitro/animal	Extracts/constituents	Preclinical
Anti-inflammatory	In-vitro/animal	Picosides/extracts	Preclinical
Immunomodulatory	Animal/in-vitro	Extracts	Preclinical
Anticancer	In-vitro/animal	Selected constituents	Preclinical
Antimicrobial	In-vitro	Extracts	Preliminary
Metabolic effects	Preclinical + limited clinical formulations	Various studies	Requires stronger clinical evidence
Conservation biotechnology	Tissue culture/molecular studies	Picoside production/genetic diversity	Strong research opportunity

Mechanistic Perspective-



Research updates:-

- The decoction has hepatoprotective action against CCl₄-induced hepatotoxicity in rats (Chaturvedi & Singh 1969).
- Alcoholic extract demonstrated protection against hepatotoxicity caused by CCl₄, as evidenced by a significant decrease in SGOT, SGPT, and alkaline phosphate levels. (Chaturvedhi and Pandey).
- A 90% alcoholic extract's water-soluble fraction showed laxative, choleric, and smooth muscle relaxant properties. Das and Raina (1967).
- Even when exposed to CCl₄-induced liver damage, rats given alcoholic PE and chloroform extracts showed a decrease in transaminase levels.
- In dogs, alcoholic extracts exhibited hydrocholeretic activity and increased biliary bilirubin, cholesterol, and alkaline phosphatase.
- Apocyanin exhibited choleric properties. (Bara and others, 1971).
- There was noticeable hydrochloric activity in the ethanolic extract. (Vahora and others, 1972).
- Diuretic action was found in a 50% ethanolic extract. (Dhar and others, 1973).
- Kutkin and vanillic acid exhibit laxative and choleric properties. In 1976, Das et al.
- The aqueous extract has antimicrobial properties. (Vohora and others, 1972).
- P. Kurroa has had positive outcomes in bronchial asthma treatment. Rajaram (1976).

Conservation status & threats

Due to significant trade and population reductions, P. kurroa has been classified as Endangered on the IUCN Red List (latest current assessments 2021) and is included in CITES Appendix II and trade-control frameworks in numerous publications. The main risks include overharvesting of rhizomes, habitat degradation, grazing pressure, and restricted natural regeneration.³⁷

Conservation, cultivation & management approaches

Several strategies have been explored or recommended:

- **Ex situ & in vitro propagation:** To provide planting material and lessen the strain on wild stocks, tissue culture techniques (such as micropropagation and multiple shoot regeneration) have been developed.

- **Domestication & cultivation trials:** Agronomic optimization and field culture at suitable altitudes can meet market demand, but issues with size, genetic variety, and quality (phytochemical yield) need to be taken into consideration.
- **Regulatory controls & sustainable harvesting:** It is advised to implement CITES restrictions, harvest quotas, legal procurement certifications, and community-based management (benefit sharing, regulated harvesting seasons). In collecting hotspots, enforcement, rehabilitation, and habitat conservation are crucial.

Discussion-

Since Dravya guna is a discipline that is crucial to treatments, it is difficult for a person to study every single one of the millions of Dravya. Therefore, the dravyas with similar features are collected and researched in one manner or another to make the study of dravya simple and feasible. The three main Ayurvedic treatises- Charaka Samhita, Sushruta Samhita, and Ashtanga Hridaya-recognize Picrorhiza kurroa, also known as Kutki, as a medicinal plant. In classical literature, such as Bhavprakash Nighantu, Kutki is utilized by a number of synonyms. Kandaruha (the plant can grow from stem cuttings), Chakrangi (the stem looks like a wheel when cut), Matsyashakala (the rhizome resembles fish scales), Ashoka (relieves grief), Rohini (protects organs with regenerative ability), Katurohini (has regenerative action), Krushnabheda (can cause black stools), Tikta (has a very bitter taste), Katumbhara (full of bitter principles), and Matsyapitta (bitter taste like fish bile and similar action).

Conclusion-

Picrorhiza kurroa is a Himalayan plant with significant medical value that is under threat. Regulation, community involvement, cultivation, ex-situ propagation, strict phytochemical standardization, and clinical research are all necessary for conservation in order to protect biodiversity and a sustainable supply of medicines. In addition to Deepan, Bhedana, and Hrudya karma, as well as Laghu and Ruksha guna, Kutaki is a medication with Kapha-Pittahara qualities. Laghu guna is easily absorbed, but Ruksha guna relieves blockage by absorbing the Kleda of Medadusti and Pittadusti. Therefore, the medication was taken for the research, which was carried out to determine its effects.

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References-

1. Kumar V, Antil M, Kumar D, Minocha N, Ankur. Importance of ayurvedic medicine in modern lifestyle: A keynote review study. International Journal of Advanced Educational Research,2016:1(4):31-33.
2. Nandha R, Singh H. Amalgamation of ayurveda with allopathy: A synergistic approach for healthy society. International Journal of Green Pharmacy,2013:7173-176.
3. Abu-Shanab, B., Adwan, G. M., Abu Safiya, D., Jarrar, N., & Adwan, K. (2005). Antibacterial activities of some plant extracts utilized in popular medicine in Palestine. Turkish Journal of Biology, 28(2 4), 99-102.
4. Joy KL, Ramadasankuttan. Inhibition by picrorrhiza kurroa extract of oxygen free radical reactions and hepatic fibrosis in rats. J Clin Biochem Nutr 1999;27:9e17.
5. HUTCHINSON J. 1973. The Families of Flowering Plants. Oxford University Press, Oxford.
6. Katoch M, Fazil IS, Suri KA, Ahuja J, Oazi JN. Effect of altitude on picroside content in core collections of Picrorhiza kurroa from the north western Himalayas.Journal of Natural medicine 2011;65:578-582.
7. Dutt S, Kiddle G, Singh B, Khambay B, Foyer CH. Differential accumulation of picrosides in Picrorhiza kurroa Royle ex. Benth. Plants 2004. www.rothamstedinternational.org/html/publication/news-letters/dondec04.pdf.

8. Kumari I, Kaurav H, Chaudhar G. Ethnobotanical Significance of *Picrorhiza kurroa* (Kutki), a Threatened Species. *Int J Res Rev.* 2021;8: 363-368.
9. Ashok Seth, THE HERBS OF AYURVEDA, Vol-1-4 Sheth Brothers 2006.
10. Nisha S, Vijaylata P, Bikram S, Raghubir C. Intraspecific Variability of Main Phytochemical Compounds in *Picrorhiza Kurroa* Royle Ex Benth. From North Indian Higher Altitude Himalayas Using Reversed-Phase High-Performance Liquid Chromatography. *J Med Plants Res.* 2012;6: 3181-3187.
11. Priyavratna Sharma, *Dravyaguna vigyan* 2nd part, Chaukhamba Publication Varanasi, 2008.
12. Kothari V, Punjabi A, Gupta S. Optimization of microwave assisted extraction of *Annona squamosa* seeds. *The Icfr Journal Life science* 2009;3:55-60.
13. Thani PR, Sharma YP, Kandel P, Nepal K. Standardization of Extraction Techniques of Picroside-I and Picroside-II from "Kutki" (*Picrorhiza kurroa* Royle ex Benth). *Global Journal of Science Frontier Research: C Biological Science* 2018;18(1):51-56. ISSN: 2249 4626 & Print ISSN: 0975-5896
14. Vaidya AB, Sirsat MS, Doshi JC, Antarkar DS. Selected medicinal plants and formulations as hepatobiliary drugs: An over-view. *International Journal of Clinical Pharmacology and Therapeutics* 1996;14:7-11.
15. Dwivedi Y, Rastogi R, Gerg NK, Dhawan BN. Effects of picrolive, the active principle of *Picrorrhiza kurroa*, on biochemical changes in rat liver poisoned by *Amanita phalloides*. *Chung Kuo Yao Li Hsueh Pao* 1992;13:197 200.
16. Dwivedi Y, Rastogi R, Mehrotra R, Garg NK, Dhawan B. Picrolive protects against aflatoxin B1 acute hepatotoxicity in 1993;27:189-199. rats. *Pharmacology Research*
17. Chander R, Kapoor NK, Dhawan BN. Picrolive, Picroside-I and Kutkoside from *Picrorhiza kurroa* are scavengers of superoxide anions. *Pharmacology* 1992;44(1):180-183. *Biochemical*
18. Pandey BL, Das PK. Immunopharmacological studies on *Picrorrhiza kurroa* Royle ex. Benth. Part-IV: Cellular mechanisms of anti-inflammatory action. *Indian Journal of Physiology and Pharmacology* 1989;33:28-30.
19. Dhawan BN. Picroliv-A New Hepatoprotective Agent from an Indian Medicinal Plant, *Picrorhiza Kurroa*. *Med Chem Res.* 1995;5: 595-605.
20. Nisha S, Vijaylata P, Bikram S, Raghubir C. Intraspecific Variability of Main Phytochemical Compounds in *Picrorhiza Kurroa* Royle Ex Benth. From North Indian Higher Altitude Himalayas Using Reversed-Phase High-Performance Liquid Chromatography. *J Med Plants Res.* 2012;6: 3181-3187.
21. Dhawan BN. Picroliv-A New Hepatoprotective Agent from an Indian Medicinal Plant, *Picrorhiza Kurroa*. *Med Chem Res.* 1995;5: 595-605.
22. Nisha S, Vijaylata P, Bikram S, Raghubir C. Intraspecific Variability of Main Phytochemical Compounds in *Picrorhiza Kurroa* Royle Ex Benth. From North Indian Higher Altitude Himalayas Using Reversed-Phase High-Performance Liquid Chromatography. *J Med Plants Res.* 2012;6: 3181-3187.
23. Katoch M, Fazli IS, Suri KA, Ahuja A, Qazi GN. Effect of Altitude on Picroside Content in Core Collections of *Picrorhiza kurroa* from the North Western Himalayas. *J Nat Med.* 2011;65: 578-582.
24. Sturm S, Stuppner H. Analysis of cucurbitacins in medicinal plants by high pressure liquid chromatography-mass spectrometry. *Phytochem Anal.* 2000;11: 121-127.
25. Ernst E. Major Herbs of Ayurveda. *Focus Altern Complement Ther.* 2010;8: 98.
26. Simons JM, Hart BA, Ip Vai Ching TRAM, Van Dijk H, Labadie RP. Metabolic Activation of Natural Phenols into Selective Oxidative Burst Agonists by Activated Human Neutrophils. *Free Radic Biol Med.* 1990;8: 251-258.
27. Visen PKS, Saraswat B, Patnaik GK, Agarwal DP, Dhawan BN. Protective activity of Picroliv Isolated from *Picrorhiza Kurroa* against ethanol toxicity in isolated rat hepatocytes. *Indian J Pharmacol.* 1996;28: 98-101.
28. Sakamoto Y, Inoue N, Nakanishi Y, Ninomiya K, Yoshikawa M, Muraoka O, Manse Y, Morikawa T. Hepatoprotective Principles from the Rhizomes of *Picrorhiza kurroa*. *Chem Pharm Bull (Tokyo).* 2023;46: 848-855.
29. Rastogi R, Srivastava AK, Srivastava M, Rastogi AK. Hepatocurative effect of Picroliv and silymarin against aflatoxin B1 induced hepatotoxicity in rats. *Planta Med.* 2000;66: 709-713.

30. Kumar R, Gupta Y, Singh S, Raj A. Anti-inflammatory Effect of *Picrorhiza kurroa* in Experimental Models of Inflammation. *Planta Med.* 2016;82: 1403-1409.
31. Baruah CC, Gupta PP, Nath A, Patnaik LGK, Dhawan BN. Anti-allergic and anti-anaphylactic activity of picroliv - A standardised iridoid glycoside fraction of *Picrorhiza kurroa*. *Pharmacol Res.* 1998;38: 487-492.
32. Joy KL, Kuttan R. Anti-Diabetic Activity of *Picrorrhiza Kurroa* Extract. *J Ethnopharmacol.* 1999;67: 143-148.
33. Rajkumar V, Guha G, Ashok Kumar R. Antioxidant and Anti-Neoplastic Activities of *Picrorhiza Kurroa* Extracts. *Food Chem Toxicol.* 2011;49: 363-369.
34. Ma S, Wang X, Lai F, Lou C. The beneficial pharmacological effects and potential mechanisms of picroside II: Evidence of its benefits from in vitro and in vivo. *Biomed Pharmacother.* 2020;130:110421. DOI:10.1016/j.biopha.2020.110421.
35. Almeleebia TM, Alsayari A, Wahab S. Pharmacological and Clinical Efficacy of *Picrorhiza kurroa* and Its Secondary Metabolites: A Comprehensive Review. *Molecules.* 2022;27(23):8316. DOI: 10.3390/molecules27238316.
36. Mehta S, Sharma AK, Singh RK. Advances in ethnobotany, synthetic phytochemistry and pharmacology of endangered herb *Picrorhiza kurroa* (Kutki): A comprehensive review (2010–2020). *Mini Rev Med Chem.* 2021.
37. Rastogi S, Kapta SK, Chauhan R. Exploring the Untapped Potential: *Picrorhiza kurroa* Royle ex Benth (Kutki) Cultivation in the Western Himalayas-A Review. *Indian Forester.* 2025;151(1). DOI:10.36808/if/2025/v151i1/170618.