Katuki (Picrorhiza Kurroa) - A promising Ayurvedic Herb

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ABSTRACT

Through much of human history, plants have been the basis for medical treatments and such traditional medicine is still widely practiced today [1]. India and China are one of such countries who boost their traditional systems of medicines and the respective Govt. of these countries also takes required measures from time to time. According to an estimate made by the World Health Organisation (W.H.O.) traditional medicine forms the basis of primary healthcare of about 80% population of the world. Primary reason for that being the inexpensive nature of herbal medicines as compared to modern pharmaceutics as these can be grown from seed or gathered from nature for little or no cost. Katuki (Picrorhiza kurroa Royle ex Benth) is a very popular hepatoprotective drug in Ayurvedic system of medicine. P. kurroa is mainly used for the treatment of hepatic disorders, but it is also known for its anti-inflammatory, anti-microbial, anti-diabetic, immunomodulator, anti-asthma and in the management of obesity. The most important of these bioactive compounds of plants are iridoids, cucurbitacin and acetophenones. The present review study is an attempt to provide reported detail information of this herb from various Samhitas and its study in modern area like its phytoconstituents and pharmacological activities.

ARTICLE INFO

Received: April 29, 2021
Published: May 28, 2021

Citation: Diksha Raina, Sumit Raina, Brajeshwar Singh. Katuki (Picrorhiza Kurroa) - A promising Ayurvedic Herb. Biomed J Sci & Tech Res 36(1)-2021. BJSTR. MS.ID.005805.

Keywords: Katuki; Picrorhiza kurroa; Hepatoprotective; Iridoids; Phytoconstituents

Introduction

Katuki or Picrorhiza is a well-known herb for its hepatoprotective action and its wide range of pharmacological activities. Katuki is known to help in removing the excess fire energy from our body thus acting as a cooling agent. It balances pitta and kapha which can cause acidity, digestive problems and fat. So, it helps to improve digestion, metabolism of carbohydrates, proteins and fats. With improved metabolism various problems like increased level of urea, creatinine, diabetes, heat and hyperthyroidism can be managed. This drug is known to be in medicinal use since 5000 years ago.

Nirukti of Katuki

a. Tikta: Means bitter, it is bitter in taste thus called Katuki/Katuka [2]
b. Katuka: Because it increases the bile secretion in our body [3].

Scientific Classification

i. Scientific Name: Picrorhiza kurroa
ii. Kingdom: Plant
iii. Order: Lamiales
iv. Family: Plantaginaceae
v. Genus: Picrorhiza
vi. Species: kurroa

Classification in Ayurvedic Texts [2, 27, 28]

Ghana

i. Charaka: Bhedaniya, Lekheniya, Stanyashodhana, Tikta skandhas
ii. **Sushruta**: Patolyadi, Pippalyadi, Mustadi

iii. **Vaghbhatta**: Patolyadi, Mustadi, Pippalyadi

**Part Used**

Root and Rhizome.

**Vernacular Names**

The regional names of Katuki in India are shown below:

i. **Sanskrit**: Katuka, Tikta, Katurohini, Kaandrooha, Krishna bheda

ii. **Hindi**: Katuka

iii. **Bengali**: Kattki

iv. **Punjabi**: Kaundd

v. **Marathi**: Bal kadu, Kali katuki

vi. **Gujarati**: Kadu

vii. **Telugu**: Katukarohini

viii. **Tamil**: Katukarogini

**Ayurvedic Properties** [3]

i. Rasa: Tikta rasa

ii. Guna: Ruksha and Laghu

iii. Virya: Sheeta

iv. Vipaka: Katu

v. Karma: Kapha-pittahara property

**Synonyms**

i. Pradhana Nama (Main Name): Katuka, Tikta, Katurohini

ii. Upama (Representation): Matsyashakla

iii. Svarupa (Morphology): Chakrangi, Krishna bheda, Shat parva

iv. Due to regeneration from stem: Kaandrooha

v. Karma (Action): Amghani, Arishta

**Botanical Description**

*P. kurroa* is a hairy herb with perennial bitter rootstock. The rhizome has fishy scales, on transverse section a blackish circular ring is seen. Rootstocks as thick as the little finger, clothed with withered leaf-bases. Leaves: 5-10 cm. rather coriaceous, tip rounded, base narrow into a winged sheathing petiole. Spikes: 5-10 cm. long, sub-cylindric, obtuse, many flowered, sub-hirsute, bracts oblong or lanceolate, as long as the calyx. Sepals: - 6mm. long, ciliated. Corolla: It is of short stamened form 6mm. long with longer filaments 8mm. long, of the longer stamened form 6mm., with filaments 2cm. long. Capsule: 1.3cm long. Rhizomes: straight or slightly arched cylindrical up to 12 cm. long and 4 to 10 mm. in diameter. Other surface is grey or creamish brown in colour, bearing impressions of round root scars and numerous scales. The rhizome terminates in scaly leaf, bud or stem. Fracture: short and clear Odour: faint or disagreeable Taste: very bitter and long standing (Figure 1).

**Distribution**

Generally, occurs in Alpines, Himalayas from Kashmir to Sikkim at 9000-15000 ft above sea level. In Jammu & Kashmir it can be collected from Galhar region of District Kishtwar having GPS location 33020’250N and 75055’590 E at an elevation of 1581 masl (Figure 2).

**Phytochemical Properties**

The major chemical constituents are D-mannitol, Kutkiol, Kutkisterol, apocyanin, phenol glucosides, androsim, and picein iridoid glycosides; kutkin, picroside I, II & III; Kutkoside, minecoside, picrorhizin, arvenin I. Kutkin is the active principle of *P. kurroa* and is comprised of kutkoside and the iridoid glycoside picrosides
I, II, and III. Other active constituents are drosin, apocynin, and nine cucurbitacin glycosides whereas catechol - apocynin has been found active as an anti-inflammatory agent and cucurbitacins for antitumor and cytotoxic effects. Chemical studies on the rhizomes of *P. kurroa* revealed acetophenones, cucurbitacins and iridoids presence in them. As per literature there are several bioassays on the constituents isolated from the rhizomes focused on hepatoprotective, immune-modulating and antioxidant activities [31].

**Pharmacological Actions**

**Hepatoprotective Activity:** Katuki has been widely known and used as hepatoprotective agent. In liver injury mainly Kuffer cells cause problems in regeneration process and it here where extract of this plant plays its role by suppressing cells [4]. Picroliva iridoid glucoside compound [ mixture of Picroside-1 and Kutkoside (1.0: 1.5, w/w)] from rhizome and roots of this plant is prominently known to help in regeneration. This hepatoprotective activity of picroliv was studied in rats liver where hepatic injury was induced by ethanol [5]. This plant has been currently used in treating various liver diseases which includes fatty liver, viral hepatitis, ischemic injury, cirrhosis, radiation toxicity etc. Studies proved picroliv effective in hepatoprotective action against paracetamol, carbon tetrachloride, alcohol and aflatoxin Zhang, et al. [6].

**Anti-Asthmatic Activity:** Phenolic Glycoside named androsin is found prominently active in anti asthmatic effects. This glycoside activity in studied in guinea pigs where it inhibit allergen as well as Platelet-activating factor (PAF) induced obstruction in bronchia [7]. Inhibiting histamine release in chopped lungs of guinea pigs was also observed by exposing them to root powder of this plant [8].

**Anticancer Activity:** Picroliv, from Picrorhiza kurroa showed protective action against chemically induced tumour [9]. This purified iridoid glycoside mixture (100 and 200 mg/kg, p.o) showed promising anti-tumour response by inhibited the sarcoma development induced by 20-MC in a dose-dependent manner by 47 and 53% in BALB/c mice. Moreover oral as well as topical use of Picroliv inhibit papilloma formation in mice model induced by DMBA. Moreover anti- invasion activity in MCF-7 cells (Human breast cancer) through the down regulation of matrix metalloproteinases (MMPs) by Kutkin, Picroside I, and Kutkoside has been reported Rathee, et al. [10]. These Picrosides are known to act as potential anti-carcinogenic agents by exhibiting different anticancer activities which includes metal ion chelator, free radical scavenging activity, detoxifying activity , cell cycle regulation and apoptotic induction [11].

**Anti-Microbial Activity:** The antibacterial and antifungal activity of Rhizome extract was evaluated by using cup plate method, where they found methanolic extract inhibit bacterial strains *E. coli, B. subtilis, S. aureus* and aqueous extract inhibit fungal strain *A. niger* and *C. albicans* [30]. In another study by using agar well diffusion method they found ethanolic extract of rhizome showed high antibacterial activity in the range 10.3 to 16.16mm against *S.aureus, B.cereus, Ecoli, K.pneumoniae, S.pyogen* and *S.pyogens* whereas the methanolic extracts showed high antibacterial activity against *S.aureus (12.1 ± 0.13mm) and Paeruginosa (13.06 ± 0.15mm)* Kumar, et al. [12]. According to the literature there are vast diversity of microbial flora in this plant termed as endophytes and current findings suggest that these endophytes might be responsible for all its medicinal properties. One such report by Raina, et al. [13] where they investigated antibacterial and antifungal activities of *Picrorhiza kurroa* harboring endophytes and they identified two bacterial endophytes i.e., which were effective against several human pathogens.

**Anti-Inflammatory Activity:** Picroliv is also known for anti-inflammatory responses. Rhizome extracts was reported to be effective in a dose dependent manner in rats against carrageenan-induced paw edema and cotton pellet-induced granuloma formation [14]. Picroliv role was also studied for anti-inflammatory response in ulcerative colitis (UC) mice model which suggested that its administration could be a therapeutic approach [6]. Alcoholic extract of kurroa and compounds kutkin, Picroside-1 and Kutkoside have been reported for their anti-inflammatory activity [15].

**Anti-Diabetic Activity:** Extract of this plant is providing beneficial results in diabetes also. Study has demonstrated that its administration increased insulin production in rats which had Streptozotocin Evoked β-Cell Damage [18]. In vivo studies in rats suggested that its extract played potential role in type-2 diabetes induced by streptozotocin-nicotinamide [16].

**Anti-Oxidant Activity:** Ethanolic extract of rhizome has been reported in scavenging free radicals which ultimately can prevent many ailments in humans. It has also its role in diseases related oxidative stress and it can also be given as natural antioxidants supplement [17].

**Immunomodulator Activity:** Aqueous and ethanolic extracts of *Picrorhiza kurroa* have been reported for stimulating humora; responses by various immune mechanisms which includes mediators releasing in hypersensitivity as well as tissue responses at the target site organ of these mediators Sharma, et al. [29]. One of the Biopolymeric fraction from this plant RLJ-NE-205 also showed cell-mediated immune response by stimulating CD4+ and CD8+ T cells Gupta, et al. [19].

**Types of Katuki**

The Nighantu works have described two varieties of Katuki viz., Katukarohini(*P. kurroa*), Ashoka rohini(*E. paniculata*)

**Samanya Karma of Katuki:** (Table 1)
**Adulteration:** The stems and roots of the same plant are commonly used to adulterate the rhizomes of Katuka/katuki. *Gentiana kurroa* Royle, *Gentiana decumbens* Linn. f., *Gentianatenella Fries*, *Helleboursniger* Linn. are used as substitute for Katuka [20]. Roots of *Picrorhizascrophulariiflora* Pennell, *Actaea spicata*, *Cimicifugafoetida*, *Coptisteeta*, *Cosciniumfenestratum*, *Swertia chirata* [21] Roots of *Lagotis glauca* Gaertn. are sometimes intentionally collected and mixed by the local sellers of Kashmir and Kullu regions [7].

**Table 1:** Actions mentioned in various Ayurveda text [2, 20, 23-28].

| Karma                  | C.S. | S.S. | A.H. | B.N. | SO.N. | SH.N. | R.N. | D.N. |
|------------------------|------|------|------|------|-------|-------|------|------|
| Bhedniya (Purgative)   | +    |      |      |      |       |       |      |      |
| Dipana (Digestive)     |      | +    | +    | +    |       |       |      |      |
| Lekhaniya (Weight reducing) | +    |      |      |      |       |       |      |      |
| Hrudya (Cardiac Tonic) |      |      |      | +    | +     | +     |      |      |
| Stanyashodhana (Galacto Purifying) | +    | +    | +    | +    | +     | +     | +    | +    |
| Jwarahna (Anti-pyretic) |      |      |      | +    | +     | +     | +    | +    |
| Shvashara (Bronchial Antispasmodic) |       |      |      |      |       |       |      |      |
| Kaas hara (Bronchial Sedative) | +    |      |      |      |       |       |      |      |
| GulmaevumShoola Nashak (Pain Killer) | +    |      |      |      |       |       |      |      |
| Aamhar (Carminative)   | +    | +    | +    | +    | +     | +     | +    | +    |
| Kushtaghna (Curative of Dermatosis) |      |      |      |      |       |       |      |      |
| Kamlahara (Curative of Jaundice) | +    | +    | +    | +    | +     | +     | +    | +    |

**Some Important Formulations**

i. Arogyavardhini gutika

ii. Tiktaka ghrita

iii. Mahatiktaka ghrita

iv. Sarva jvarahara lauha

v. Katukadya ghrita

**Therapeutic Uses**

i. Hridroga- Katuki and Madhuka are taken with sugar dissolved in water in Pitta Hridroga [C.S. Cl. 26 & A.H. Cl. 6]

ii. Pandu-Katuki, sugar and Drona pushpi juice as Anjana [S.B.M.]

iii. Kushtha-Katuki, ativisha, ushira and Chandana are collectively given for internal usage [C.S. Cl. 7]

iv. Useful in diabetic diuresis

v. Useful in cough

**Conclusion**

Katuki has been one of the important sources of Ayurvedic medicine as well as modern medicine. Although it’s majorly used for liver disorders, but its active components present in various parts of plant are providing relief and saving millions of life from the very ancient time. Due to wide spectrum of biological activities this plant is widely used in drug industries. Iridoids present in it is also widely known for antitumor, choleric, hypolipidemic, antiphosphodiesterase, cardioprotective, neurotogenic, molluscicidal and leishmanicidal activities [22]. This plant also contain sveron-icoside, phenol glycosides and pilurolside. Besides roots and rhizome leaf, stem and seeds are also a source of variety of components which makes this plant a remarkably promising herb [23-29].

**References**

1. (2007) Hard to swallow Nature 448(7150): 105-106.
2. Bhramanand (2015) Tripathi Ashtanga Hridayam with Nirmala Hindi Commentary, pp. 199-202.
3. DS Lucas (2013) Dravyaguna Vijnana 2: 311-314.
4. Kumar N, Singh AK (2013) Phalatrika dikvatha-An ayurvedic hepatoprotective drug. International journal of research in pharmacy and chemistry 3(3): 591-594.
5. Verma PC, Basu V, Gupta V, Saxena G, Rahman LJ (2009) Pharmacology and Chemistry of a Potent Hepatoprotective Compound Picroliv Isolated from the Roots and Rhizomes of Picrorhiza kurroa Royleex Benth (Kutki). Current Pharmaceutical Biotechnology 10(6): 641-649.
6. Zhang DK, Yu JJ, Li YM, Wei LN, Yu Y, et al. (2012) A Picrorhiza kurroa Derivative, Picroliv, Attenuates the Development of Dextran-Sulfate-Sodium-Induced Colitis in Mice. Mediators of Inflammation 16(10): 751629.
7. Dorsch W, Suppner H, Wagner H, Gropp M, Demoulin S, et al. (1991) Antiasthmatic effects of Picrorhiza kurroa: Androsin prevents allergen and PAF-induced bronchial obstruction in guinea pigs. Int Arch Allergy App Immunol 95(2-3): 128-133.
8. Mahajani SS, Kulkarni RD (1977) Effects of disodium cromoglycate and Picrorhiza kurroa root powder on sensitivity of guinea pigs to histamine and sympathomimetic amines. Int Arch Allergy app Immunol 53(2): 137-144.
9. Rajeshkumar NV, Kattan R (2001) Protective Effect of Picroliv, the Active Constituent of Picrorhiza kurroa, Against Chemical Carcinogenesis in Mice. Teratogenesis, Carcinogenesis, and Mutagenesis 21(4): 303-313.
10. Rathee D, Thanki M, Bhuvu S, Anandjiwala S, Agrawal R (2013) Iridoid glycosides-Kutkin, Picroside I, and Kutkoside from Picrorrhiza kurroa Benth inhibits the invasion and migration of MCF-7 breast cancer cells...
through the down regulation of matrix metalloproteinases. Arabian Journal of Chemistry 6(1): 49-58.

11. Soni D, Grover A (2019) "Picrosides" from Picrorhiza kurroa as potential anti-carcinogenic agents. Biomedicine & Pharmacotherapy 109(1): 1680-1687.

12. Kumar PV, Swaraj A, Madhumitha G, Saral AM, Kumar BS (2010) In vitro antibacterial activities of Picrorhiza kurroa rhizome extract using agar well diffusion method. International Journal of Current Pharmaceutical Research 2(1): 30-33.

13. Raina D, Singh B, Bhat AK, Satti NK, Singh VK (2017) Antimicrobial activity of endophytes isolated from Picrorhiza kurroa Royle ex Benth. Indian Phytopathology 70(4): 40-44.

14. Kumar R, Gupta YK, Singh S (2016) Anti-inflammatory and anti-granuloma activity of Berberis aristata DC. in experimental models of inflammation. Indian J Pharmacol 48(2): 155-161.

15. Singh GB, Bani S, Singh S, Khajuria A, Sharma ML, et al. (1993) Anti-inflammatory Activity of The Iridoids Kutkin, Picroside-1 and Kutkaside from Picrorhiza kurroa. Phytotherapy research 7(6): 402-407.

16. Husain GM, Singh PN, Kumar V (2009) Antidiabetic activity of standardized extract of Picrorhiza kurroa in rat model of NIDDM. Drug Discov Ther 3(3): 88-92.

17. Khandekar S, Pansare T, Pachpor A, Maurya SK (2019) Role of katuka (Picrorhiza kurroa Royle ex Benth) in obesity W.S.R to Ayurvedic and modern aspect: A review. International Journal of Herbal Medicine 7(6): 31-35.

18. Kumar S, Patial V, Soni S, Sharma S, Pratap K, et al. (2017) Picrorhiza kurroa Enhances b-Cell Mass Proliferation and Insulin Secretion in Streptozotocin Evoked b-Cell Damage in Rats. Frontiers in Pharmacology 8: S37.

19. Gupta A, Khajuria A, Singh J, Bedi KL, Satti N K, et al. (2006) Immunomodulatory activity of biopolymeric fraction RLJ-NE-205 from Picrorhiza kurroa. International Immunopharmacology 6(10): 1543-1549.

20. PV Sharma (1982) Dhanvantray Nighantu.

21. J L N Sastry,Tanuja M Nesari (2018) A textbook of Dravya Gunaj Vijnana, pp.159-162.

22. Sah J N, Varshney V K (2013) Chemical constituents of Picrorhizae genus: a review American Journal of Essential Oils and Natural Products 1(2): 22-37.

23. H S Pandakara (2002) Arunadatta and Ayurvedarasayana of Hemadri, Ashtanga Hridaya with the Commentaries Sarvangasundara Chaukhambha Orientalia (9th Edn.), p. 234.

24. Chaturvedi GN, Singh RH (1965) Treatment of jaundice with an indigenous drug Picrorhiza kurroa Royale (A clinical and experimental study). Curr Med Pract, pp. 451-461.

25. PV Sharma (2018) DravyaGunaVijnana, pp. 441-443.

26. K C Chunekar, G S Pandey, Bhavaprakash (2015) Nighantu with Vidyohtini Hindi Commentary, Chaukhambha Sanskrit Sansthana,Varansi. Reprint, pp. 67-69.

27. (2017) KavirajAmbikadutt Shastri, Sushruta Samhita with Ayurveda Tatva Sandipika Hindi Commentary, Chaukhambha Sanskrit Sansth Sansthana Varanasi. pp.184,185,187

28. (2017) Pandit Kashinath Shastri, Dr. Gorakhnath Chaturvedi with Vidyohtini Hindi Commentary, Chaukhambha Bhard Academy. Reprint 1.

29. Sharma P, Kumar P, Sharma R, Gupta G, Chaudhary A (2017) Immunomodulators: Role of medicinal plants in immune system. National Journal of Physiology, Pharmacy and Pharmacology 7(6): 552-556.

30. Sharma SK, Kumar N (2012) Antimicrobial screening of Picrorhiza kurroa Royle ex Benth rhizome. Int J Curr Pharm Rev Res 3(3): 60-65.

31. Rathee D, Rathee P, Rathee S, Rathee D (2012) Phytochemical screening and antimicrobial activity of Picrorhiza kurroa, an Indian traditional plant used to treat chronic diarrhoea. Arab J Chem 39(S2).