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A REVIEW ON MEDICINALLY IMPORTANT SPECIES OF PICRORHIZA

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Abstract: India is known as the "vegetable emporium of the world". Ayurveda more precisely known as the science of life has delivered cures for dreaded diseases right from the existence of mankind as old as 5,000 B.C. Amongst many useful herbs the plant Picrorhiza (Katuki) considered as a bitter drug has been used in treating liver disorders since antiquity. Lord Dhanwantari has introduced this particular herb considering the mythological tradition of India. The herb has also long been used in Chinese system of medicine. This essential plant is sometimes adulterated with some other plant species that resembles its morphological characters. The genus has two species P. kurroa and P. scrophulariiflora which are unique in their own characteristics and the plant is mainly found in the Himalayan region. In a bid to achieve symptomatic fast relief often some essential herbs are overlooked, one such plant is Picrorhiza. Thus an effort has been made in reviewing the available literatures that are available about the plant in the most common texts which would provide a structure for the use of the herb for a layman also who needs to be aware about the standards that are mentioned and how are they mentioned at the same time to highlight the use of this traditional plant.

Keywords: Ayurveda, Picrorhiza, Therapeutic uses, Classical literatures

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INTRODUCTION

Natural products have been an important resource for the maintenance of life for ages. Already in the earliest written traditions *e.g.* the Rig-Veda of South Asia (1500-900 BC), it is evident that plants played an important role in daily life. One of the best-known examples is Soma, a plant that was pressed to yield juice, which was used as a medicine. The interest in medicinal plants has never ceased since even today, natural products become increasingly important as a source of pharmacotherapeutics [1].

One of the plants mentioned in Ayurveda having important medicinal properties is 'Katuka'. Hindi derivative of 'katuka' is generally known as kutki. In several Nighantus the synonym and properties of katuka are mentioned.

The name of Picrorhiza is derived from the bitter root, where "Picros" means bitter, while "rhiza" means root. The specific name kutki is derived from "Karu", the Punjabi name of the plant, which means bitter as well [2].

In Indian mythology the herb katuka is said to have been administered by Dhanwantary, the God of medicine himself and because of this it is also known as Dhanwantary-grastya [3].

Picrorhiza species is generally collected at the base of the Zemu glacier in Sikkim at 4300 meter, and is identified as *Picrorhiza kurroa*. The picrorhiza species belongs to the genus *Picrorhiza* are characterized into two species [4], one of the dry western (*Picrorhiza kurrooa*), and the other of the moist eastern Himalaya (*Picrorhiza scrophulariiflora*).The plant *Picrorhiza scrophulariiflora* (Scrophulariaceae) grows in the high altitude regions (over 4,400 mt) in the southeast of Tibet and the northwest of Yunnan in China. The roots of this plant, known to be rich in terpenoids, iridoid glycosides, phenolic glycosides and phenylethanoid glycosides are used in Traditional Chinese Medicine for the treatment of damp-heat dysentery, jaundice etc[2].

Picrorhiza rhizome or 'Indian gentian' obtained from *Picrorhiza kurroa* contains bitter iridoid glycosides. It is used in India to treat liver ailments, blood and burning sensation, curing fever caused by kapha-pitta, expelling urinary disease (prameha), leprosy (kustha)[4].

'Picrorhizae' consists of the dried rhizome with root of *Picrorhiza kurroa* Royle or of *Neopicrorhiza scrophularriflora* Hong [Syn: *Picrorhiza scrophulariiflora* Pennell] (Scrophulariaceae). The rhizomes of *Neopicrorhiza scrophulariiflora* Hong [syn. *Picrorhiza scrophulariiflora* Pennell] are taxonomically similar and have been used in traditional medicine for the same purposes and traded under the same vernacular names. [5]

Commercial market samples of *P. kurroa* are often adulterated with *Latotis*

cashmiriana (Selaginaceae). Though the latter grows with *P. kurroa* at similar elevations between 3,200-4,500 mt which does not possess hepatoprotective properties [6].Where else dried roots and rhizomes of Picrorhiza is used as a substitute of Indian Gentian (*Gentiana kurroo*) and considered to be a bitter tonic almost as efficacious as Gentian. [7]

Bitter Glycoside: In general, bitters are the edible natural products mostly consumed before any normal meals to stimulate as well as enhance the appetite. However, the bitter glycosides as a class do possess almost similar activities like the bitters such as: digestive, stomachic and febrifuge. Therapeutically, the bitters have been found to exert their stimulant effects on the gustatory (*i.e.* related to the sense of taste) nerves located in the mouth and ultimately give rise to an improved gastric juice secretion in the stomach. The bitter glycosides have been found not confined to the same chemical class, but the most important ones amongst them essentially possess the pyran cyclopentane ring. A number of bitter glycosides isolated from natural plants have been put into actual therapeutic practice, namely: Picrorhiza, Gentian**,** and Chirata[8].

Iridoid glycosides: Iridoid are a class of secondary metabolites found in a wide variety of plants and in some animals. They are monoterpenes biosynthesized from isoprene and they are often intermediates in the biosynthesis of alkaloids. Chemically, the iridoids usually consist of a cyclopentane ring fused to a six-membered oxygen heterocycle. Cleavage of a bond in the cyclopentane ring gives rise to a subclass known as seco-iridoids. Iridoids are typically found in plants as glycosides, most often bound to glucose. Iridoid are found in many medicinal plants and may be responsible for some of their pharmaceutical activities. Isolated and purified, iridoids exhibit a wide range of bioactivities including cardiovascular, antihepatotoxic, choleretic, hypoglycemic, analgesic, anti-inflammatory, antimutagenic, antispasmodic, antitumor, antiviral, immunomodulator, and purgative activities. The iridoids are produced by plants primarily as a defense against herbivores or against infection by microorganisms. To humans and other mammals, iridoids are often characterized by a deterrent bitter taste [8, 9]. Aucubin and catalpol are two of the most common iridoids in the plant kingdom. Iridoids are prevalent in the plant subclass like Ericaceae, Rubiaceae, Scrophulariaceae, Valerianaceae, and Menyanthaceae. In the plants of the genus picrorhiza, kutkoside and kutkin is present which is known to be the mixture of picroside I and picroside II [10], which are C-9 monoterpene iridoid glycosides. The chemical structure of picroside I and picroside II are as follows. Indian Himalayan region is one of the richest sources of biological diversity and has been a major source of herbal raw materials. Picrorhiza kurroa is endemic to Himalayan region and

grows from Kashmir to Sikkim at an altitude of 3000-5000 mt. A bitter extract rich in iridoid glycosides from the dried roots and rhizomes has hepatoprotective, anticholestatic, antioxidant, anti-inflammatory and immune modulating activities.

SCROPHULARIACEAE – THE FIGWORT FAMILY:

Introduction: This is a large plant family, with around 3000 species in around 200 genera, mainly found in the northern temperate regions of the world. Many of the plants in this Family are popular garden plants like tiny alpines; other plants in this family grown for ornament include Mimulus, Penstemon, Hebe, and Calceolaria. One or two are grown also for the production of the drugs notably Digitalis (Foxglove) for digitalin.

Habit: Most of them are herbaceous, with a few shrubs and climbers, with one genus of trees (*Paulownia*). Some of them are semi-parasitic (annual or perennial herbs or under shrubs).

Flowers: The flowers are usually zygomorphic and the stamens reduced to four anatomical characters include glandular hairs in which the head is divided by vertical walls only, and the stomata, which are surrounded by three or more epidermal cells. Calcium oxalate is relatively rare; when present, it occurs in small solitary crystals. Scrophulariaceae flowers have distinctly two-lipped corollas, with the upper lip divided into 2 lobes, and the lower into 3. Mostly The calyx is usually five-lobed, but may be four-lobed. Most have 2 pairs of stamen, but there may from 2 to 5, in pairs or individual. The calyx under the flowers has five lobes, and the flowers are usually borne in spikes. There are two main flower shapes. Some species have four petals, but many have irregular shaped flowers with five petals, often joined to form a bell or tube, sometimes with two lips. In some species, there is a long hollow spur with honey to attract pollinators. There are two long and two short stamens attached to the petals.

Leaves: Generally, the leaves are opposite or alternate, without stipules, and may be evergreen. Sometimes, they are lobed or cut.

Seeds**:** The seed capsule in this family is inside the flower (superior), and has two parts, each with many small seeds [11].

REVIEW OF CLASSICAL LITERATURE:

Katuki is known in ayurveda as ‘katuka’. In several Nighantus and Samhitas, the synonym and the properties of katuka are mentioned. In ‘Vedas’ there is no written description is given. Following is an overview of some representative sources in which katuka is described. From various Ayurvedic literatures starting from Samhitas to Nighantus we get the various description of the plant Katuki. Even we can find the scattered references in the classics like Caraka Samhita [12],Susruta Samhita

[13],Astang Samgraha [14] ,Dhavantari Nighantu [15].In Dhavantari Nighantu various synonyms of katuka is mentioned like matsyaskala, katuka, tikta, cakrangi, asokarohini, tiktakarohini, arista, janani. Here also the properties of katuka is been mentioned like tikta, katu, pittajit. Katuka conquers cold, blood and burning sensation, destroys kapha and overcomes digestion of food and removes remittent fever (Visamajvaranasini).List of formulation mentioned in Sarangadhara Samhita [16] where Katuki is one of the main ingredient.

Raj Nighantu: Ras of katuki is katu; veerya is sita and well known for the disease like jwar, swas pira, kaphaj disease, rajyakshma, ruche bardhak[17].

Bhavaprakasa Nighantu: Different synonyms like katvi, tikta, asoka, katuka, katambhara, rohini and katurohini are mentioned. Rasa of Katuka is tikta. Guna is rukshma, sita, laghu. Vipak of katuka is katu and it works as agnidipak and the other indications of katuka are pittajwar, prameha, swash, kasa, rakta dosa, daha, kustha, kriminasak[18].

Shankar Nighantu: In this the various synonyms are mentioned with its description, properties and dose[19].

Nighantu Adarsa: In this text we found the drug is called as 'katuki' or 'kutki', also the synonyms and 'nirukti' for the plants are mentioned. With this distribution, description and upayog of the drug is also mentioned. Most importantly the main part of use is also described as root (Mool) and also it has been confirmed that though it is supposed that *Gentiana kurroo* (trayaman) and *picrorhiza kurroa* are same but they are different from each other[20].

REVIEW OF MODERN LITERATURE:

The present era is a time of technological advancements coupled up with stringent uses of drugs that are bound to give values. Thus there lies an utmost necessity in reviewing the modern literatures that are considered as standards by the I.S.M. This gives a proper implication of the particular medicinal part of the plant that should be used to give therapeutic efficacies and at the same time to understand the mechanism of action of the particular chemical constituent that is giving the desired result.

In ayurvedic classics we also get the description of both the species belonging from genus 'Picrorhiza' from many contemporary books, are described here.

Distribution of *Picrorhiza kurroa*:

Katuka consists of the dried rhizome with root of *Picrorhiza kurroa* (Fam. Scrophulariaceae); a perennial, more or less hairy herb common on the northwestern Himalayas from Kashmir to Sikkim[21, 22, 23, 24, 25, 26].

Synonyms of *Picrorhiza kurroa*:

In Sanskrit it is known as Tikta, Tikta rohini, Katurohini¸ Sutiktaka, Kauka; in Assamese it

is called as Katki, Kutki; in English it is known as Black Hellebore [19], Hellebore [23, 24], Yellow gentian [3]; in Guajarati it is known as Kadu, Katu; in Hindi it is called Kutki. This plant also known as Katuka rohini, katuka rohini in Kannada; Kutki, Kalikutki in Marathi; Katuki in Oriya; Karru, kaur in Punjabi; Katuka rohini, Katuku rohini, Kadugurohini in Tamil[21, 22, 23, 24, 25, 26].

Morphology of the plant *Picrorhiza kurroa*:

The stems and the conical buds along with the drugs usually form a part of the drug itself [8]. The rhizome of this perennial herb is long, externally grayish-brown, surface rough due to longitudinal wrinkles & Taste is bitter[23] Rhizomes are jointed and zigzag, cylindrical, irregularly curved with branching and rooting at the jointed nodes[26]. The roots are invariably wrinkled in the longitudinal fashion having transverse cracks. They are grayish to brown in appearance, while the fracture is tough [8].Root stacks are irregularly curved as thick as the little finger [3, 25]. Leaves are basal and alternate with terminal spikes present in this species. They are of 5-10 cm in length [23, 25]. In the flower, calyx are generally 5 in number; corolla are of almost 9-10 mm long, 4-lobed, and bilabiate; stamens slightly di-dynamous almost equaling corolla [23]. Stem is small, weak, creeping, erect at flowering, leafy, and slightly hairy [26].

Microscopic character of medicinally important parts (Rhizome and Root) of *Picrorhiza kurroa*: [5, 6, 23]

Rhizome – The rhizome consists of 20-25 layers of cork consisting of tangentially elongated, suberised cells; cork cambium is generally 1-2 layered; cortex single layered or absent, primary cortex persists in some cases, one or two small vascular bundles present in cortex; vascular bundles surrounded by single layered endodermis of thick-walled cells; secondary phloem composed of phloem parenchyma and a few scattered fibers; cambium 2-4 layered; secondary xylem consists of vessels, tracheids, xylem fibers and xylem parenchyma, vessels vary in shape and size having transverse oblique articulation; tracheids long, thick-walled, lignified, more or less cylindrical with blunt tapering ends; xylem parenchyma thin-walled and polygonal in shape; centre occupied by a small pith consisting of thin-walled cells; simple round to oval, starch grains, measuring 25-104 µm in dia., abundantly found in all cells.

Root -Young root generally have single layered epidermis, some epidermal cells elongate forming unicellular hairs; hypodermis single layered; cortex is 8-14 layered consisting of oval to polygonal, thick-walled, parenchymatous cells; primary stele tetrarch to heptarch, enclosed by single layered pericycle and single layered, thick-walled cells of endodermis; mature root shows 4-15 layers of cork, 1-2 layers of

cork cambium; secondary phloem poorly developed; secondary xylem consisting of vessels, tracheids, parenchyma and fibers; vessels have varying shape and size, some cylindrical with tail like, tapering ends, some drum shaped with perforation on end walls or lateral walls; tracheids cylindrical with tapering pointed ends; fibers aseptate, thick-walled, lignified with tapering blunt chisel-like pointed ends.

Microscopy of root powder – In colour it is dusty grey; shows groups of fragments of cork cells, thick-walled Parenchyma, pitted vessels and aseptate fibers, simple round to oval, starch grains are generally 25 - 104 µm in diameter.

Chemical Constituents of *Picrorhiza kurroa*:

The therapeutically potent constituents of the drug essentially comprises of *three* vital bitter glycosides**,** namely: Picroside I, Picroside II *and* Kutkoside. Among them chemically both Picroside and Kutkoside are C-9 monoterpenes. Iridoid glycosides having an epoxy moiety present in the cyclopentane ring. Besides, it also contains organic acids, resin, sugar and tannins along with cucurbitacin glycosides (highly oxygenated triterpenes), apocycynin androsin, D-mannitol, Kutkiol, Kutkisterol, Apocyanin, Phenol glucosides, Androsin, and Picein Iridoid glycosides, Kutkin, Picroside I, II, III, IV, V, Kutkoside, Picrorhizin[3, 21, 22, 23, 24].

Ayurvedic properties and action of *Picrorhiza kurroa*: [23, 24, 27]

Rasa-Katu, Tikta; Guna-Laghu; Virya-Usna; Vipaka-Katu; Karma-Hridaya, Pitta-hara, Deepaniya, Bhedini, Jvarahara.

Important formulation of *Picrorhiza kurroa*: [23]

Arogyavardhini Gutika is a formulation mainly used for Pitta vikar (disease due to abnormality of Pitta) like skin diseases and blood disorders like jaundice, anaemia and useful in poor appetite and one of the major ingredients is Katuka.

Tiktaka Ghrita is a formulation mainly used in Kandu, Meda, Gulma, Grahani and Katuka is also used to prepare the formulation.

Sarvajvarahara Lauha is an ayurvedic formulation mainly used in Jirna-jvara; Pliha-roga, Yakrit-roga.

Mahatikataka Ghrita is a formulation found in Bhaisajya Ratnavali and used for all chronic skin diseases that are deep in the plasma, blood and muscle tissue with red eruptions and itching. In this formulation one of the main ingredients is Katuka.

Uses of *Picrorhiza kurroa*:

Traditional uses: This plant is used as Svasa, Daha, Jvara, Kamala, Kustha, and Arocaka [3].

Modern uses: The dried roots & rhizomes are used as hepatoprotective, antiasthemic, immunomodulatory agent particularly for liver disorders & jaundice, fever, dysentery and diarrhea [23].

Ethno veterinary uses: *Picrorhiza kurroa* is used in various diseases including fever in domestic animals. The roots are used as an appetite in swine [3].

Monograph for *Picrorhiza kurroa*:

The monograph of the plants as mentioned in the authoritative and standard texts which are approved by the government of India are tabulated in below table (Table No. 01)

Dose of *Picrorhiza kurroa*:

1- 3 gm of the drug in powder form [23].

Distribution of *Picrorhiza scrophulariiflora*:

This plant is mainly found in the Himalayas, from Kashmir to Sikkim at an elevation of 2,700-4,500 mt. Its rhizome are generally used in the Tibetan & Chinese traditional medicine to treat various ailments like liver disease, fever, asthma, jaundice & also have pharmaceutical values for hepato protective, antiasthma activities [1, 4, 28].

Synonyms of *Picrorhiza scrophulariiflora*:

In Sanskrit it is known as katuki, katuka-rohini, tikta, matsyapitta; in English it is called Picrorhiza; in Hindi it is called Kutki; in Bengali it is known as Karu. It is also known as Kutki, Kaduki, Katuki, Katuko, Kutke in Nepal; and as Hu Huang Lian in China [28, 29, 30].

Morphology of *Picrorhiza scrophulariiflora*:

The plant is low (about 10-20 cm in height), hairy, perennial herb and its flowering time is from July- August [29]. The rhizome of this perennial herb is long, externally pale (grayish)-brown covered with dried leaves, surface rough due to longitudinal wrinkles and taste is bitter [30, 31]. Rhizomes and roots are intact; grayish brown in colour with numerous circular
root scars and short thin fractures and longitudinally wrinkled [30]. Leaves basal, alternate, acuminate, serrate, stalked, winged, oblanceolate or narrowly spathulate, each leaf is 2 -6 cm long and 0.5 -1.2 cm wide, usually 10-20 per rosette; serrate in upper half; surfaces glabrous or sparingly short-glandular-hairy [30, 31]. Flowers are dark blue purple, the flowering time is July – August. The flowers are found in a dense terminal spikes arising from a rosette of conspicuously toothed leaves, Calyx are generally 5 in no. Corolla is of almost 9-10 mm long, 4-lobed, and bilabiate; stamens slightly didynamous almost equaling corolla [30, 31]. Fruits are capsule & 6-10 mm in size, and ovoid, swollen. Seeds are pale brown in colour, and reniform, and 1 x 0.8 mm in size, the fruiting time is October –November [31].

Microscopic character of Rhizome and leaf of *Picrorhiza scrophulariiflora*:

Rhizome – The rhizome was distributed by well-developed cork layers and collenchyma. Large numbers of

aerenchymas distributed widely in leaf, aerial stem and rhizome [32].

Leaf – Leaf surface was covered with two kinds of glandular hair, and the stoma was anomocytic type. Moreover, the leaf was isolateral and differed from most of alpine plant. The aerial stem had well-developed mechanical tissue [32].

Chemical Constituents of *Picrorhiza scrophulariiflora*:

In the roots of *Picrorhiza scrophulariiflora* a bitter cucurbitacin glycoside is present together with three known indoidal glycosides, amphicoside (picroside- Ⅱ), catalpol, aucubin a phenol glycoside, androsin, minecoside and scroside and a known cucurbitacin glycoside [33].

Therapeutic uses of *Picrorhiza scrophulariiflora*:

The root of *Picrorhiza scrophulariiflora* is used in Nepal as a cathartic, in cases of dyspepsia as a purgative, and to treat scorpion bites. The dried rhizome is antibacterial, anti-inflammatory, anti-periodic and laxative (in small dose) [29].

SCIENTIFIC STUDIES DONE ON GENOUS *PICRORHIZA*:

Pharmacognostical evaluation

Microscopy of rhizome of *Picrorhiza kurroa* and its powder character: Transverse section of *Picrorhiza* rhizome shows the important parts like cork, cambium, cortex, endodermis, xylem, phloem and pith and also in powder microscopy starch grains, pigment cells, and cortical parenchyma can be seen [34].

Analytical study:

TLC: TLC of alcoholic extract of the drug on Silica gel 'G' plate using Choloroform:Methanol (95: 5) shows under U.V. light (366 nm) three fluorescent zones at Rf. 0.05 (blue), 0.30 (blue) and 0.35 (green). On exposure to Iodine vapour nine spots appear at Rf. 0.10, 0.17, 0.21, 0.30, 0.37, 0.41, 0.62, 0.72 and 0.84 (all yellow). On spraying with 5% methanolic sulphuric acid reagent and heating the plate for about ten minutes at 105°C seven spots appear at Rf. 0.05, 0.10, 0.17, 0.21, 0.30, 0.41 and 0.84 (all brownish grey) [23].

Quantitative study: In *Picrorhiza kurroa* the two iridoid glycosides kutkoside and picroside-I were found to have the active hepatoprotective principles and their quantification was performed for the routine quality control of Kutki extract. For the Quantitation of these phytoconstituents a precise and rapid thin-layer chromatography (TLC) method was developed. The analysis was performed on a TLC precoated silica gel 60 F254 plate with ethyl acetate: methanol: glacial acetic acid: formic acid (25:5:1:1) as mobile phase. Densitometric evaluation of kutkoside and picroside-I was carried out at 265 nm and the mobile phase showed good resolution with *R*f values 0.42_0.03 and 0.61_0.03 for kutkoside and picroside-I, respectively. The

content of kutkoside and picroside-I was found to be 2.18 and 1.90%, respectively, and was comparable with those obtained by HPLC. The linearity was found to be in the range of 80–480 ng/spot for both kutkoside and picroside-I. The average recovery values were found to be 96.5 and 96.0% for kutkoside and picroside-I, respectively [35].

Qualitative study: In *Picrorhiza kurroa*, picroside I and II are the active ingredients responsible for its medicinal effect. These chemical constituents vary according to different plants at different altitudes & this is analyzed by HPLC studies. The plants collected from the lower altitude contains less picroside content as compared to plants collected from higher altitude [36].

Pharmacological studies:

Anti-asthmatic activity: *P.kurroa* has been studied extensively for its anti-asthmatic activity. The crude extract of *P.kurroa* roots reduced the frequency and severity of asthmatic attacks and the need for regular bronchodilators. The activity has been attributed to compounds such as androsin and apocynin, which have been shown to inhibit allergen and PAF- induced broncho-constriction [37].

Digestive activity: *Picrorhiza* is used in India for the people with constipation due to insufficient digestive secretions [37].

Anti-diabetic activity: Extract of *Picrorhiza* was found to lower blood glucose in laboratory animals. Chronic administration of the extract significantly reduced blood sugar in alloxan-induced diabetic rats for 10 days. The extract was also to find to reduce the increased blood urea nitrogen & serum lipid peroxides in alloxan-induced diabetic animals and to inhibit the body weight reduction and leukopenia induced by alloxan administration [37].

Immunomodulatory activity: The effect of an ethanolic extract of each drug was studied on delayed type hypersensitivity, humoral responses to sheep red blood cells, skin allograft rejection, and phagocytic activity of the reticuloendothelial system in mice. *Picrorhiza kurroa* was found to be a potent immunostimulant of both cell-mediated and humoral activity[37].

Anti-arthritic activity: Open-label studies conducted in India show a preliminary benefit for persons with primarily rheumatoid arthritis [37].

Hypolipemic activity: A hypolipemic effect of the water extract of *Picrorhiza kurroa* was observed in a high fat diet feeding hyperlipemic mouse at doses of 50, 100 and 200 mg/kg, orally, once a day for 12 weeks. Liver weight, serum aspartate transferase (AST), alanine transferase (ALT), low density lipoprotein (LDL), triglyceride and total cholesterol levels were significantly reduced by the treatment. On the contrary, serum HDL level seems not affected by P. kurroa water extract [38].

Anti-inflammatory activity: Apocynin is a constituent of root extracts of *Picrorhiza* and has been reported to possess anti-inflammatory properties in laboratory animals. Apocynin concentration dependently inhibited the formation of thromboxane A2, whereas the release of prostaglandins E2 and F2α was stimulated. Apocynin inhibited arachidonic acid-induced aggregation of bovine platelets, possibly through inhibition of thromboxane formation [37]. The rhizome of *Picrorhiza scrophulariiflora* is used to treat inflammatory diseases as a traditional medication. The ethanol extract of *Picrorhiza scrophulariiflora* in rabbits improves accelerated atherosclerosis through inhibition of redox-sensitive inflammation [39].

Hepatoprotective activity: Alcoholic extract of the plant and kutkin possess hepatoprotective activity. Plant is a potent immunostimulant of both cell mediated and hormonal immunity and exhibits choleretic activity in dogs. *Picrorhiza kurroa* is also beneficial in the management of bronchial-asthma [37]. The hepato-protective effect of *Picrorhiza kurroa* roots have been shown in diverse models of liver injury. The crude extract, and the isolated active principles of the roots have been shown to protect the liver from various types of drug-induced injury isolated compounds from *P. kurroa* have also been shown to have hepatoprotective activity [37]. Non-alcoholic fatty liver disease (NAFLD) in rats was cured by giving standard hydro-alcoholic extracts of *picrorhiza kurroa*. It reduced the lipid content of liver significantly at the dose of 400mg/kg [40].

Anti-Diabetic activity: In the Streptozotocin induced diabetic rats were treated with a gavage of ethanol extraction of *Picrorhiza scrophulariiflora.* It reduced NADPH-oxidase dependent superoxide generation and decreased expression of malondialdehyde and advanced oxidation protein products in diabetic kidney. So, extraction of *Picrorhiza scrophulariiflora* improves diabetic nephropathy through inhibition of redox sensitive inflammation [41].

Toxicity study:

Picrorhiza is not readily water soluble & is ethanol soluble. The bitter taste makes tinctures unpalatable. So, it is therefore usually administered as a standardized (4% kutkin) encapsulated powder extract. Typical adult dosage is 400-1500 mg/day, with dosages up to 3.5 gm/day sometimes being recommended for fevers. Picrorhiza root extracts are widely used in India with no adverse effects having been reported. The LD_{50} of kutkin is greater than 2600 mg/kg in rats with no data available for humans [42].

Result and discussion

Genus Picrorhiza belonging to family Scrophulariaceae has a great importance in traditional system of medicines. Its two species *P.kurroa* and *P.scrophulariiflora*

have so much similarity[43] due to the presence of similar active constituents like picroside-I, picroside-II, kutkoside which belongs to Iridoid glycoside. Besides having similar constituents *P.scrophulariiflora* contains additional phenylethanoid glycoside and plantamajoside which are absent in the species *P.kurroa*. So *P.scrophulariiflora* is used as a better substitute for *P.kurroa*. In the recent pasts no such attempt has been made to compare and evaluate the different species of the plant katuki. So, these species might have been mixed or adulterated very easily. A lot of work has been done on *P.kurroa* but a very less work has been performed on it's another sp. named as *P. scrophulariiflora*. Thus reviewing the genus picrorhiza it is clear that the two species of the plant are unique in their characteristics and traits which implies that if a medicinal formulation is made, the specific species mentioned should be considered by evaluating its morphological, microscopical and analytical that should be considered as a proper standard. Thus whole profile of reviewing the available literature is of pre-requisite importance.

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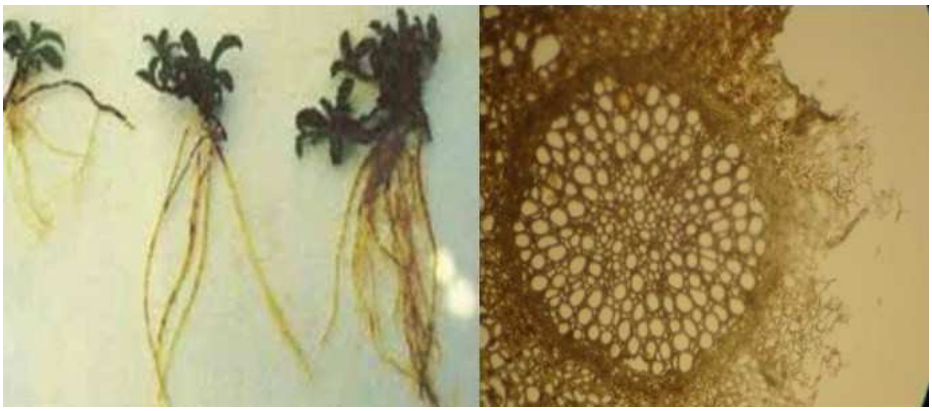

Figure 1: Root of *Picrorhiza kurroa* (Root and microscopy)

Figure 2: *Picrorhiza scrophulariiflora* (Sketch, root and microscopy)

Table No: 1

Parameters	Limits
Foreign organic matter	Not more than 2%
Total ash	Not more than 7%
Acid-insoluble ash	Not more than 1-3%
Alcohol soluble extractive	Not less than 10%
Water soluble extractive	Not less than 20%
Loss on drying	Not more than 13% water.

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