

Phcog Rev. : Plant Review

Rakta Kanchan (*Bauhinia variegata*): Chemistry, Traditional and Medicinal uses- a review

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ABSTRACT

Bauhinia variegata Linn. (Kanchnar / Rakta kanchan), is a widely used medicinal plant by the tribals throughout India and popular in various indigenous system of medicine like Ayurveda, Unani and Homoeopathy. Following the various traditional claims on utility of this plant in curing number of diseases, considerable efforts have been made by researchers to varify its utility through scientific pharmacological screenings. The notable biological activities reported are antitumour, antimicrobial, anti-inflammatory, antigoitrogenic, hepatoprotective and haemagglutination. Industrially, the plant is widely used for the manufacture of woodwool board, production of gum and fibres. The plant is also utilized for afforestation to conserve the nature. This review presents a detailed survey of the literature on pharmacognosy, phytochemistry, traditional and biologically evaluated medicinal uses of *B. variegata*.

INTRODUCTION

Bauhinia Linn. (Caesalpiniaceae) is a genus of shrubs or tree, very rarely climbers, distributed throughout the tropical regions of the world. About 15 species of this genus occur in India (1). Bauhinias are chiefly propagated from seeds; vegetative propagation except inarching has not shown much success. Many useful products such as tannins, fibre, gum and oil are obtained from *Bauhinia* spp. Many species are grown as ornamental plant. Bauhinias are also cultivated for afforestation and the manufacture of woodwool board (2).

Rakta Kanchan (*Bauhinia variegata* Linn.) is a medium-sized, deciduous tree, found throughout India, ascending to an altitude of 1,300 m in the Himalayas. It is commonly known as Kanchnar in Sanskrit and Mountain Ebony in English (3). In Sanskrit the word Kanchnar means "A glowing beautiful lady". A freshly collected bark of the plant is greyish brown externally and cream colored internally. The internal surface, however, gradually turns red and on drying becomes brown and smooth. The external surface remains greyish brown and rough due to large number of exfoliations, transverse cracks and fissures. On drying, the bark becomes curved and channeled. The fracture is short outside and fibrous within. Leaves are 10-15 cm long, rigidly sub-coriaceous and deeply cordate. The flowers are bisexual, irregular and light magenta in color. The pods are long, hard, flat, dehiscent and 10-15 seeded (4).

The various parts of the plant viz., flower buds, flowers, stem, stem bark, leaves, seeds and roots are practiced in various indigenous systems of medicine and popular among the various ethnic groups in India for the cure of variety of ailments. Following a large number of claims on the wide range of folk curative properties of *B. variegata*, considerable efforts have been made by the researchers to justify its efficacy as a curative agent through pharmacological investigations. The aim of present review is to highlight the traditional uses, phytochemical and pharmacological investigations carried out on the plant, to explain the multifaceted role of this medicinal plant.

Pharmacognostical Studies

Microscopic studies of flowers showed uni to multicellular covering trichomes broad at the base and pointed at the apex and thin walled multicellular ballon shaped glandular trichomes. Pollen grains are spheroidal in equatorial view, tricolporate, broadly opened with large, thickened and circular pores. Exine is thick, differentiated into sexine and nexine. Ovary is superior with marginal placentation (5). Transverse section of the bark shows 12-20 layers of cork cells. The cork is followed by a single layer of phellogen, beneath which a wide zone of phellogen of tangentially elongated to isodiametric cells. Lignified fibres and stone cells are found distributed in this region. The pericyclic fibres are broad, lignified, thick walled and have narrow lumen and tapering ends. The phloem is represented by sieve tubes, companion cells, phloem parenchyma, phloem fibres, crystal fibres and stone cells, transversed by uni to biseriate medullary rays (6).

Traditional Uses

Folk medicine

The aborigines of Ghatigaon forests, Gwalior, Madhya Pradesh using the flower buds of *B. variegata* for the treatment of diarrhoea, dysentery and haemorrhoids (7). The flowers are used in piles, oedema, dysentery (8), as laxative and anthelmintic (9).

The bark of the plant is medicinally more important and used by tribals for cure of variety of ailments. The bark is used in fever, as tonic and astringent (10), as antileprotic, in skin diseases and wound healing (11), antigoitrogenic (12), and as antitumour (13). The leaves are used in treatment of skin diseases and stomatitis (14). The roots of the plant are used as an antidote for snake poisoning, in dyspepsia, flatulence and as carminative (7, 10). They are also reported to be useful as antitumour and in obesity (15).

Ayurveda

In Ayurvedic literatures the plant is known by various names as Kanchnar, Gandari, Yugmapatra and Karbudara. It is

reported to have Kasaya rasa, Ruksha guna, Shita virya and Katu vipaka. The stem bark of *B. variegata* is used in the treatment of krimiroga (worm infestation), gandamala (scrofula), apaci (cervical lymphadenitis) and vrana (wounds) (16-17).

Unani

In Unani system of medicine bark of the plant is described as astringent to the bowels, tonic to the liver. It is reported to be useful in treatment of leucoderma, leprosy, menorrhagia, asthma, wounds and ulcers. The flower buds are claimed useful in piles, cough, eye diseases, liver complaints and as styptic in haematuria and menorrhagia (18, 19).

PHYTOCHEMICAL STUDIES

Root bark and root: Phytochemical analysis of the root bark of *Bauhinia variegata* Linn yielded a new flavanone, (2S)-5, 7-dimethoxy-3', 4'-methylenedioxyflavanone and a new dihydridibenzoxepin, 5, 6-dihydro-1, 7-dihydroxy-3, 4-dimethoxy-2-methyldibenzoxepin. The structures of the new compounds were determined on the basis of spectral studies (20). A novel flavonol glycoside 5,7,3',4'-tetrahydroxy-3-methoxy-7-O- α -L-rhamnopyranosyl(1 \rightarrow 3)-O-beta-galactopyranoside isolated from the roots of *B. Variegata* and its structure was identified by spectral analysis and chemical degradations (21).

Stem bark and stem: The stem bark showed presence of hentriacontane, octacosanol, stigmaterol (22) and of sterols, glycosides, reducing sugars and nitrogenous substances on preliminary phytochemical screening (23). The stem yielded a flavonone glycoside characterized as 5, 7-dihydroxyflavonone-4 -O - α - L - rhanmopyranosyl- B - D - glucopyranoside (24). The isolation of β -sitosterol, lupeol, kaempferol-3-glucoside and a 5, 7-dimethoxyflavonone-4 -O - α - L - rhanmopyranosyl- B - D-glucopyranoside was also reported from the stem of the plant (25, 26). A flavonol glycoside, characterized as kaempferol-3-glucoside, was isolated from stem of this plant (27). A new phenanthraquinone, named bauhinione, has also been isolated from *B. variegata*, and its structure has been elucidated as 2, 7-dimethoxy-3-methyl-9, 10-dihydrophenanthrene-1, 4-dione on the basis of spectroscopic analysis (28).

Leaves: Two new long chain compounds, heptatriacontan-12, 13-diol and dotetracont-15-en-9-ol have been isolated from the leaves of *B.variegata*. Structures of these compounds have been elucidated by spectral data analysis and chemical studies (29).

The leaves were also found to contain crude protein, calcium and phosphorous. Due to its nutritive value, the leaves were recommended as fodder for cattle (30).

Buds: Keto acids of flowering buds were analyzed during their development and correlated with the free amino acids and amides. Only four amino acids appeared in early stages. α -alanine, aspartic acid, glycine, serine and glutamic acid were present in all samples. Glutamic acid showed a sharp drop from initial to later stages. Phosphoenolpyruvic acid, oxaloacetic acid and α -ketoglutaric acid appeared in latter stages. Their absence in early stages attributed to their rapid utilization in floral bud development (31).

PHARMACOLOGICAL STUDIES

Antitumour activity

The antitumour activity of the ethanol extract of *Bauhinia variegata* (EBV) has been evaluated against Dalton's ascitic lymphoma (DAL) in Swiss albino mice. A significant enhancement of mean survival time of EBV-treated tumour bearing mice was found with respect to control group. EBV treatment was found to enhance peritoneal cell counts. After 14 days of inoculation, EBV is able to reverse the changes in the haematological parameters, protein and PCV consequent to tumour inoculation (32). The antitumour activity of ethanol extract of *B.variegata* was evaluated against Ehrlich ascites carcinoma in Swiss albino mice and found to be a potent cytotoxic towards Ehrlich ascites carcinoma tumour cells (33). The chemopreventive and cytotoxic effect of ethanol extract of *B.variegata* (EBV) was evaluated in N-nitrosodiethylamine (DEN, 200 mg/kg) induced experimental liver tumor in rats and human cancer cell lines. Oral administration of ethanol extract of *B. variegata* (250 mg/kg) effectively suppressed liver tumor induced by DEN as revealed by decrease in DEN induced elevated levels of serum glutamate pyruvate transaminase (SGPT), serum glutamate oxaloacetate transaminase (SGOT), alkaline phosphatase (ALP), total bilirubin, gamma glutamate transpeptidase (GGTP), lipid peroxidase (LPO), glutathione peroxidase (GPx) and glutathione S-transferase (GST). The extract produced an increase in enzymatic antioxidant (superoxide dismutase and catalase) levels and total proteins when compared to those in liver tumor bearing rats. The histopathological changes of liver samples were compared with respective controls. EBV was found to be cytotoxic against human epithelial larynx cancer (HEp2) and human breast cancer (HBL-100) cells. These results showed a significant chemopreventive and cytotoxic effect of ethanol extract of *B.variegata* against DEN induced liver tumor and human cancer cell lines (34).

Anti-inflammatory activity

A novel flavonol glycoside 5,7,3',4'-tetrahydroxy-3-methoxy-7-O- α -L-rhamnopyranosyl(1 \rightarrow 3)-O-beta-galactopyranoside isolated from the roots of *B. variegata* showed significant anti-inflammatory activity (35).

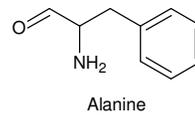
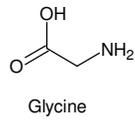
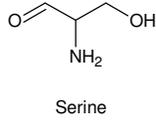
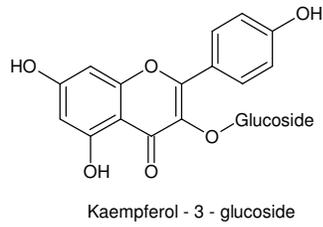
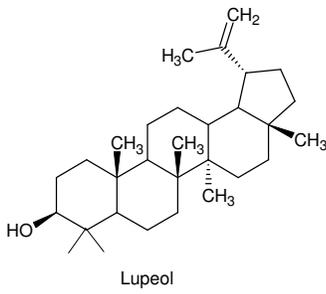
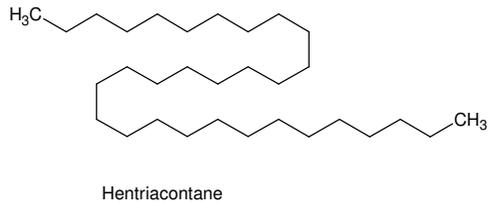
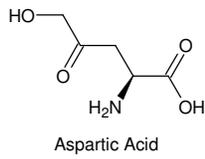
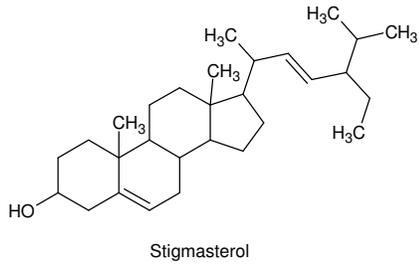
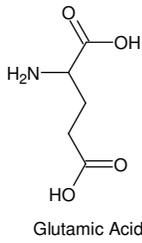
Antigoitrogenic activity

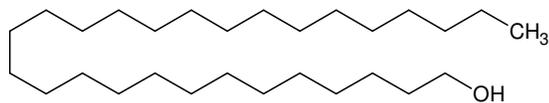
The effects of *B.variegata* were studied on rats with goitre induced by neomercazole and found to be effective in bringing the goitrogenic thyroid to normal level at a dose of 200 mg/ day (36).

Antimicrobial activity

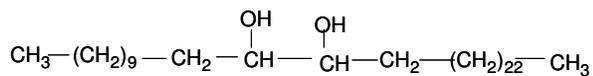
The fresh juice of the plant was found devoid of bacteriostatic activity against *Staphylococcus aureus* and *Escherichia coli* (37). In another study, the methanolic extract of leaves exhibited antibacterial activity against *Proteus vulgaris*, *Bacillus anthracis*, *Escherichia coli*, *Streptococcus agalactiae* and antifungal activity against *Aspergillus fumigatus* and *A. niger* (38). The leaf extract also exhibited toxicity against ringworms causing fungi *Epidermophyton floccosum*, *Trichophyton mentagrophytes* and *Microsporium gypseum* (39).

The aqueous and methanolic extract *B.variegata* was evaluated against five bacterial strains, viz., *Bacillus cereus*,

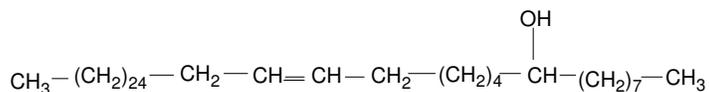




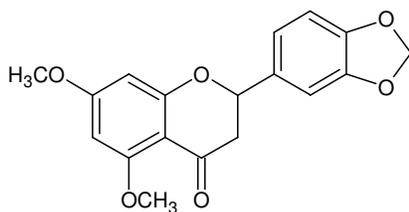
Octacosanol



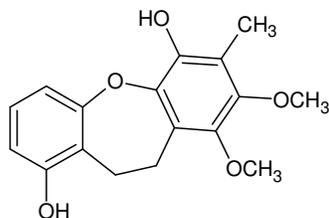
Heptatricontan-12,13-diol



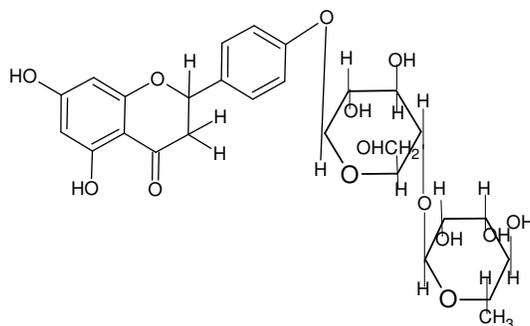
Dotetracont-15-en-9-ol



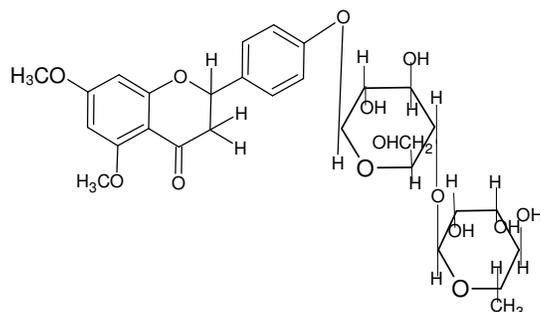
(2S)-5,7-dimethoxy-3',4'-methylenedioxyflavanone



5,6-dihydro-1,7-dihydroxy-3,4-dimethoxy-2-methylidibenz[b,f]oxepin



5, 7-dihydroxyflavanone-4'-O- α -L-rhamnopyranosyl- β -D-glucopyranoside



5, 7-dimethoxyflavanone-4'-O- α -L-rhamnopyranosyl- β -D-glucopyranoside

Staphylococcus aureus, *Klebsiella pneumoniae*, *Escherichia coli* and *Pseudomonas pseudoalcaligenes*. The most susceptible bacteria were found *K.pneumoniae* and the most resistant bacteria were *E.coli*. *B.variegata* exhibited remarkable antibacterial activity (40). In another study, *B.variegata* Linn. bark powder was defatted with petroleum ether. The non-defatted as well as defatted plant material was then individually extracted in different solvents with increasing polarity, viz., 1,4-dioxan, acetone, methanol, dimethylformamide (DMF) and distilled water respectively. The antibacterial activity of all extracts (non-defatted and defatted) was determined by agar well diffusion method at the three different concentrations of 10 mg/ml, 5 mg/ml and 2.5 mg/ml. The antibacterial activity of defatted extracts was found more than non-defatted extracts against the test microorganisms (41).

Insecticidal activity

The extract of stem of the plant showed juvenilizing activity against *Dysdercus cingulatus* nymphs (42).

Hepatoprotective activity

The Hepatoprotective activity of stem bark of *B.variegata* was investigated in carbon tetrachloride (CCl₄) intoxicated *Sprague-Dawley* rats. The alcoholic stem bark extract of the plant at different doses (100 and 200 mg/kg) were administered orally to male rats. The effect of extract on serum enzymes, viz., AST, ALP, ALT, GGT and liver proteins and lipids were assessed. The significant activity of the

extract was found at 200 mg/kg against CCl₄ induced liver damage (43).

Haemagglutination activity

The saline extract of seed exhibited haemagglutination activity against erythrocytes of man, monkey, rabbit, rat, goat, sheep, cow, buffalo, horse, mule and fowl (44).

SUMMARY AND CONCLUSION

'Necessity is the mother of invention'. This dictum fully applies to the rural or primitive societies, which have to discover solutions to almost all their needs and problems from the natural resources around them. There are over 400 different tribal and other ethnic groups in India. The tribal constitute about 7.5 % of India's population. Apart from the tribal groups, many other forest dwellers and rural people also possess unique knowledge about the plants. In recent years, ethnomedicinal studies received much attention as this brings to light the numerous little known and unknown medicinal virtues especially of plant origin. They obviously deserve evaluation on modern scientific lines such as phytochemical analysis, pharmacological screenings and clinical trials (45). In the present article, we have reviewed the relevant literatures to congregate the botanical, pharmacognostical, ethnobotanical, phytochemical and pharmacological information on *Bauhinia variegata*. A survey of literature revealed that the plant is having promising antitumour, cytotoxic, antigonitrogenic, antimicrobial, hepatoprotective, anti-inflammatory and haemagglutination

activity. A critical analysis of the literatures also pin points the fact that although the number of diseases for which *B.variegata* finds use as a medicine is fairly large, yet its therapeutic efficacy has been assessed only in few cases. In view of the wide range of medicinal uses of *B.variegata* as mentioned in ethnobotanical surveys, Ayurveda, Unani system and otherwise, it is imperative that more clinical and pharmacological studies should be conducted to investigate unexploited potential of this plant.

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