PHYTO-PHARMACOLOGICAL PROFILE OF *BAUHINIA VARIEGATA*

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Summary

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 verify its utility through scientific pharmacological screenings. The notable biological activities reported are antitumour, antimicrobial, antiinflammatory, 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*.

Keywords: *Bauhinia variegata,* phytochemistry, Pharmacology.

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.

Figure: Bauhinia variegata

PHYTOCHEMICAL STUDIES

Phytochemical analysis of the root bark of *Bauhinia variegata* Linn yielded a new flavanone, (2S)-5,7-dimethoxy-3',4'-methylenedioxyflavanone and a new dihydrodibenzoxepin, 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[5].

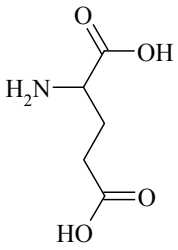
A novel flavonol glycoside 5,7,3',4'-tetrahydroxy-3-methoxy-7-O-α-L-rhamnopyranosyl (1--)3)-O-β galactopyranoside isolated from the roots of *B. variegata* and its structure was identified by spectral analysis and chemical degradations[6].

The stem bark showed presence of hentriacontane, octacosanol, stigmasterol[7] and of sterols, glycosides, reducing sugars and nitrogenous substances on preliminary phytochemical screening[8]. The stem yielded a flavonone glycoside characterized as 5, 7-dihydroxyflavonone-4–O– α -L – rhanmopyranosyl- β–D– glucopyranoside (9). The isolation of β-sitosterol, lupeol, kaempferol-3-glucoside and a 5, 7-dimethoxyflavonone-4 –O–α–L– rhanmopyranosyl- β-D-glucopyranoside was also reported from the stem of the plant[10, 11].

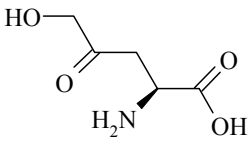
A flavonol glycoside, characterized as kaempferol-3-glucoside, was isolated from stem of this plant[12]. A new phenanthraquinone, named bauhinione, has also been isolated from *B. variegata*, and its structure has been elucidated as 2, 7-dimethoxy-3-methyl-9, 10-dihydrophenanthrene-1, 4-dione on the basis of spectroscopic analysis[13].

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[14]. 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[15].

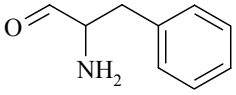
Keto acids of flowering buds were analyzed during their development and correlated with the free amino acids and amides. Only four amino acids appeared in early stages. α-alanine, aspartic acid, glycine, serine and glutamic acid were present in all samples. Glutamic acid showed a sharp drop from initial 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[16].



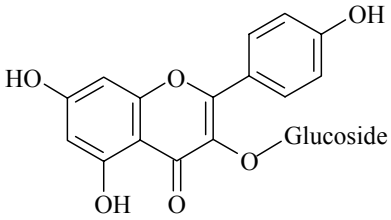
Glutamic acid



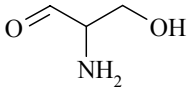
Aspartic acid



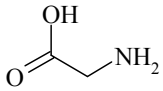
Alanine



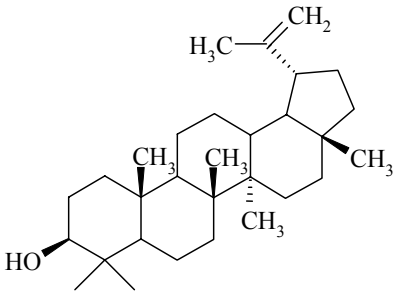
Kaempferol-3- glucoside



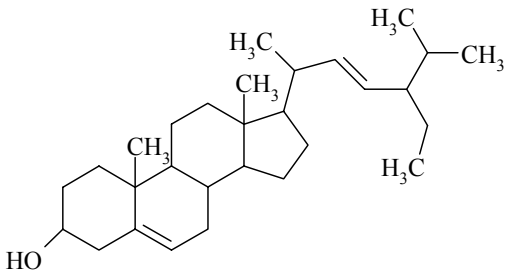
Serine



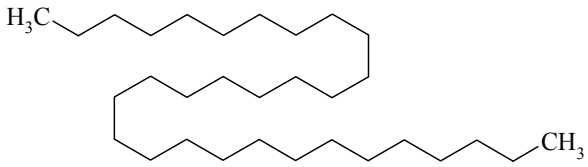
Glycine



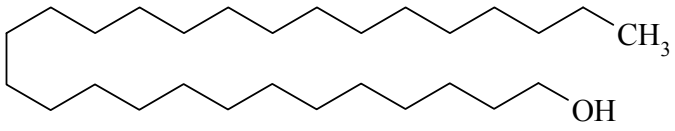
Lupeol



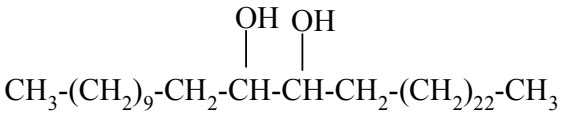
Stigmasterol



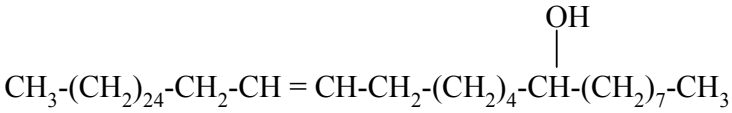
Hentriacontane



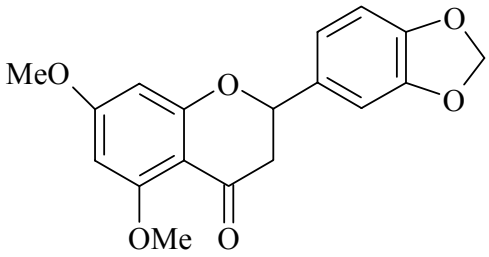
Octacosanol



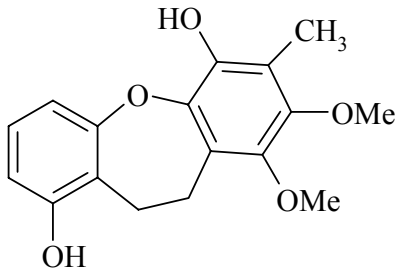
Heptatricontan-12,13-diol



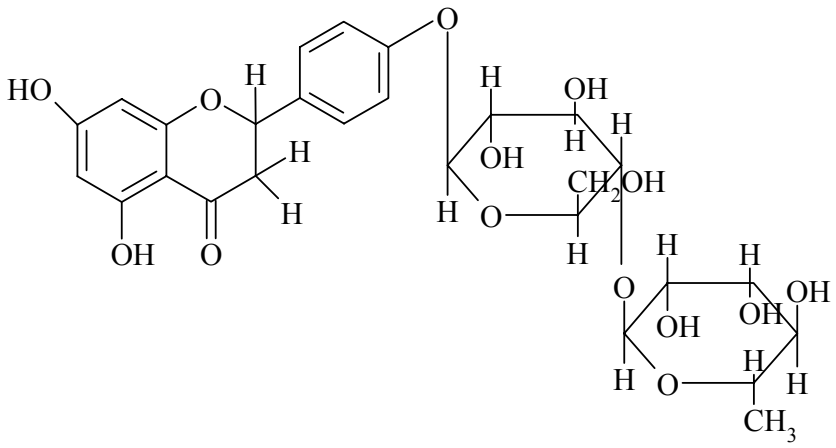
Dotetracont-15-en-9-ol



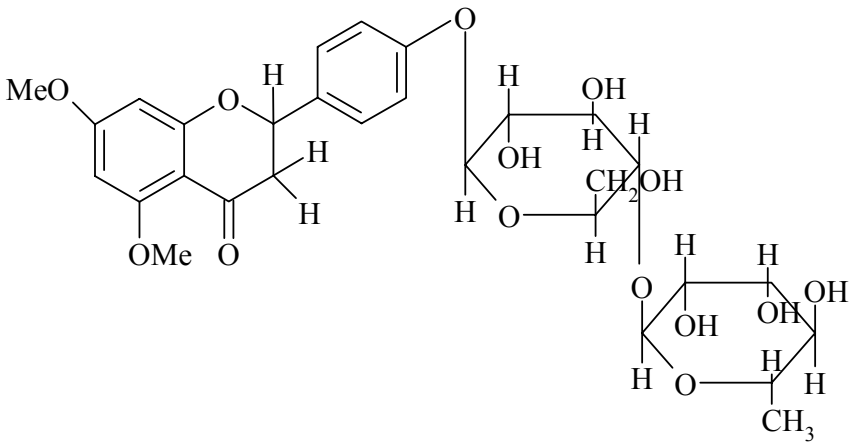
(2S)-5,7-dimethoxy-3',4'-methylenedioxyflavanone



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



5,7-dihydroxyflavanone-4'-O-a- L-rhamnopyranosyl-b- D-glucopyranoside



5,7-dimethoxyflavanone-4'-O-a- L-rhamnopyranosyl-b- D-glucopyranoside

PHARMACOLOGICAL STUDIES

Antitumor 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 tumor 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 haemotological parameters, protein and PCV consequent to tumor inoculation[17]. The antitumor 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 tumor cells[18]. 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[19].

Anti-inflammatory activity

A novel flavonol glycoside 5,7,3',4'-tetrahydroxy-3-methoxy-7-O-α-L-rhamnopyranosyl (1--)3)-O-β-galactopyranoside isolated from the roots of *B. variegata* showed significant anti-inflammatory activity[20].

Antigoitrogenic activity

The effects of *B. variegata* were studied on rats with goiter induced by neomercazole and found to be effective in bringing the goitrogenic thyroid to normal level at a dose of 200 mg/day[21].

Antimicrobial activity

The fresh juice of the plant was found devoid of bacteriostatic activity against *Staphylococcus aureus* and *Escherichia coli*[22]. 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*[23]. The leaf extract also exhibited toxicity against ringworms causing fungi *Epidermophyton floccosum, Trichophyton mentagrophytes* and *Microsporum gypseum*[24]. The aqueous and methanolic extract of *B. variegata* was evaluated against five bacterial strains, viz., *Bacillus cereus, 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[25]. 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, dimethyformamide (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[26].

Insecticidal activity

The extract of stem of the plant showed juvenilizing activity against *Dysdercus cingulatus* nymphs[27].

Hepatoprotective activity

The Hepatoprotective activity of stem bark of *B. variegata* was investigated in carbon tetrachloride (CCl_4) 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 CCl_4 induced liver damage[28].

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[29].

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