INTRODUCTION

The mountain ebony, Bauhinia variegata L., belongs to the family Leguminosae. It is distributed throughout India, ascending to an altitude of 1300 in the Himalayas. It is widely planted in the tropics and warm regions of the world. It belongs to the more than 200 species in the genus Bauhinia. It grows best in the full moon or partial shade. It is easily propagated easily from seed and by air layering. Bauhinia variegata is a medium sized deciduous tree. The genus includes trees, vines and shrubs that are frequently planted for their showy flowers and ornamental foliage. Their whole part is used for pharmacological properties. It is commonly known as Kachnar in hindi, sanskrit and mountain ebony in english. The bark of the plant is grayish brown externally and pale-pink inside and the external surface is rough because of large number of longitudinal cracks and fissures. The leaves are 10-15 cm long and broad, subcoriaceous and deeply cordate. The flowers are large, fragrant, white or purplish, appearing when the tree is leafless. The pods are 15-30 by 1.8-2.5 cm hard, flat, dehiscent and 10-15 seeded. The various parts of the plant are used in traditional system of medicines for the cure of variety of diseases. Following a large number of claims on curable properties of B. variegata, effort has been made by researcher to justify its efficacy as a curative agent through pharmacological investigations. The aim of present review article is to explain the traditional uses, pharmacognostical studies, phytochemical properties and pharmacological investigations which were carried out on the plant.

Pharmacognostical Studies

Microscopic study of flower covering trichomes showed uni to multicellular broad at the base and pointed at the apex with thin walled multicellular ballon shaped glandular trichomes. Pollen grains are spheroidal and equatorial view, tricolporate, broadly opened with large thickened and circular pores. Transverse section of the leaf petiole shows single layered epidermis covered with thin cuticle. Epidermis is made up of thin walled rectangular cells. Some of the cells show abundant solitary calcium oxalate crystals. Vascular bundles are present in prominent numbers. Xylem and phloem are well developed. Lamina of leaves shows upper and lower epidermis covered by thin cuticle and made up of thin walled rectangular cells. In the mesophyll tissue vascular bundles of the veins are vertically transparent. Midrib of leaves shows upper and lower epidermis with well developed thin cuticle. Both the epidermal cells are rectangular. Almost all cells are loaded with abundant solitary crystals of calcium oxalate and clustered crystals. The powder microscopy of leaves shows the presence of parenchyma cells with calcium oxalate crystals, vessels with helical to spiral thickening abundant crystals which are solitary and prism shaped, epidermal cells with anomocytic stomata.

Traditional Uses

In medicines, The leaves are rich in reducing sugar and have good nutritive value for the healthy development of tasar silk worms. The leaves are used for the preparation of biddies. The root is carminative and used in dyspepsia and flatulence and as an antidote to snake poison. The bark is astringent, tonic, anthelmintic, scrofula and skin diseases. The flowers and flower buds are used as a vegetables and laxative. The juice of flower is used to treat diarrhoea, dysentery and other stomach disorders. The dried buds are used for the treatment of diarrhoea and dysentery, worms, piles and tumours.

In Ayurveda, Ayurvedic literature claim the plant 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 krinroga (worm infection), gandamala (scrofula), apaci (cervical lymphadenitis) and vma (wounds).

Phytochemical Studies

Non woody aerial parts: Phytochemical analysis of non woody aerial parts yielded 6 flavonoids, namely kaempferol, ombuin, kaempferol 7,4’-dimethylether-3-o-β-D-glucopyranoside, kaempferol-3-o-β-D-glucopyranoside, isorhamnetin-3-o-β-D-glucopyranoside & hesperidin together with one triterpene caffeate, 3β trans-(3,4 dihydroxycinnamoyloxy) olean-12-en-28-oic acid.
Root: Phytochemical analysis of root yielded a novel flavonol glycosides 5,7,3,4-tetrahydroxy-3-methoxy-7-o-α-L-rhamnopyranosyl (1→3)-o-β-d-galactopyranoside. Their structures are identified by spectral analysis and chemical degradations. Phytochemical analysis of root bark yielded new flavonone (2S)-5, 7-dimethoxy-3,4-methylenedioxyflavonone and new dihydrodibenzoxepin, 5,6b-dihydro-1,7-dihydroxy-3,4-dimethoxy-2-methylidibenz (b,f) oxepin, together with three known flavonoids. The structure was determined on the basis of spectral studies.

Stem: The main chemical compounds isolated from the bark of *B. variegata* are quercitroside, isoquercitroside, rutoside, myricetol glycoside and kaempferol glycoside. Phytochemical study of stem shows β-sitosterol, lupeol and an unknown compound naringenin 5, 7-dimethyl ether 4→rhamnoglucoside. A new phenanthraquinone named Bauhinione has been isolated from *B. variegata* L. and its structure has been elucidated as 2,7-dimethoxy-3-methyl-9,10-dihydrophenanthrene-1,4-dione on the basis of spectral analysis.

Leaves: Two new long chain compounds heptatriacontane-12, 13-diol 7 dotetracont-15-en-9-ol have been isolated from leaves of *B. variagata*. Catechol, tannins, ellagic acid and sterol are also present in leaves of *B. variagata*. Leaves are also rich in Vitamin C (146mg %) and rich in reducing sugar.

Flowers: The pale-violet flowers contain cyanidin-3-glucoside, malvidin-3-glucoside, malvidin-3-diglucoside, peonidin-3-glucoside and peonidin-3-diglucoside. The white flowers contain kaempferol-3-galactoside and kaempferol-3-rhamnoglucoside.

Seed: On extraction with petroleum ether gave 16.5% of pale yellow fatty oil but only 6.1% when expressed in a hydraulic press. The fatty acid composition of the oil is as follows: myristic (1%), palmitic (17%), stearic (13.4%), lignoceric, behenic and arachidic (1%), oleic (31.8%) and linoleic acid (35.9%). It also contains myricetal glycosides. Phytochemical study shows the presence of all essential amino acids such as lysine, threonine, valine, methionine, isoleucine, leucine and phenylalanine. They also contain semi essential ones histidine and arginine. The other amino acids found are aspartic acid, serine, glutamic acid, proline, glycine, alanine and tyrosine.
**Pharmacological Studies**

**Antidiabetic activity:** Ethanol extract of leaves of *B. variegata* shows the hypoglycemic activity in 100, 86, 92, 67mg/100ml respectively with percentage reduction of 9, 21.8, 16.3 and 39.14

**Anti-inflammatory activity:** Phytochemical analysis of non woody aerial parts yielded 6 flavonoids, namely kaempferol, ombuin, kaempferol 7,4′-dimethyldihydro-3-o-β-D-glucopyranoside, kaempferol-3-o-β-D-glucopyranoside, isorhamnetin-3-o-β-D-glucopyranoside and hesperidin together with one triterpene caffeate, 3β trans-(3,4 dihydroxy cinnamoyloxy) olean-12-en-28-oic acid. These seven compounds from non-woody aerial parts show the anti-inflammatory activity against inhibiting the lipopolysaccharides and interferon γ induced nitric oxide (NO) and cytokines.8

A novel flavonol glycoside 5,7,3′,4′-tetrahydroxy-3-methoxy-7-0-α-L-rhamnopyranosyl (1→3) 0-β-D-galactopyranoside has been isolated from the ethanol extract of root of *B. variegata* which shows the anti-inflammatory activity by non-immunological carrageenan induced hind paw edema method.9

**Immuno-modulatory activity:** Ethanolic extract of the stem bark of *B. variegata* shows the immunomodulatory activity on the primary and secondary antibody responses by humoral antibody response for specific immune response. Phagocytic activity test and neutrophil activation test were evaluated by the carbon clearance and neutrophil adhesion test for a nonspecific immune response respectively. Increase in phagocytic index and percentage neutrophil adhesion at the doses of 250 and 500mg/kg/p.o. has been found.9

**Anti-tumour activity:** Anti-tumour activity on the ethanolic extract of the stem of *B. variegata* has been evaluated against Dalton’s ascitic lymphoma (DAL) on Swiss albino mice. This ethanolic treatment enhance the peritoneal cell counts which during the presence of tumour. The average number of peritoneal exudates cells per normal mouse was found to be 5.8±5.4×105. ethanolic *B. variegata* (250mg/kg) single treatment enhance the peritoneal cells to 8.6±1×106 while two consecutive treatment enhanced the number to 9.7±1.2×106 6,15

Ethanolic extract of the stem of *B. variegata* shows chemoprevention and cytotoxic effect against N-nitrosodiethylamine induced experimental liver tumour in rats and human cancer cell lines at a dose of 200mg/kg. Oral administration of ethanolic extract of *B. variegata* effectively suppressed liver tumour induced by N-nitrosodiethylamine as revealed by decrease in N-nitrosodiethylamine induced elevated level 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), glutathione-s-transferase (GST). Ethanolic extract was found to be cytotoxic against human epithelial larynx cancer and human breast cancer (HBL-100) cells.16

**Hepatoprotective activity:** Ethanolic extract of the stem bark of *B. variegata* shows hepatoprotective activity against carbon tetra chloride induced hepatotoxicity in Sprague-Dawley rats at the dose of 100 and 200 mg/kg. Oral administration of ethanolic extract decrease the level of AST, ALT, ALP, GGTT, total lipids & increase the level of total protein which increase during the hepatotoxicity and decrease the level of total proteins.15

**Antibacterial activity:** Methanolic and aqueous extract of stem bark of *B. variegata* shows antibacterial activity by both agar disc diffusion method and agar well diffusion method against five bacterial strains viz. *Bacillus cereus, Staphylococcus aureus, Klebsiella pneumonia, Escherichia coli*, *Pseudomonas pseudoalcaligenes*. Antibacterial activity in melonie extract is more potent than aqueous extract. *B. variegata* L. exhibited remarkable antibacterial activity.18

**Haemagglutinating activity:** Crude seed protein of *B. variegata* shows haemagglutinating activity.19

**Haematinic activity:** Ethanolic extract of the stem bark of *B. variegata* shows haematinic activity on haemolytic anaemic rats.20

**Antimicrobial activity:** Ethanolic extract of the stem bark of *B. variegata* was found to have antimicrobial activity against *B. subtilis, P. aeruginosa, S. typhi, S. dysenteriae, S. aureus* and *Vibrio cholerae*. For this organism the minimum bacterial concentration (MBC) of crude extract was 0.39mg/ml. The ethanolic extract was found to be more effective against gram positive than gram negative bacterial.21

**Antilucre activity:** Ethanolic extract of the stem of *B. variegata* shows the antilucre activity against gastric ulcer induced by pyloric ligation and aspirin induced ulcer model in rats. Ethanolic extract decrease the volume of gastric secretion, total, free acidity and ulcer index with respect to control which increase during ulcer.22

**Anticarcinogenic activity:** Methanolic extract of stem bark of *B. variegata* shows anticarcinogenic activity using two stage protocol in skin papilloma model in swiss albino mice against 7, 12- dimethylbenz (a) anthracene (DMBA) and croton oil induced skin carcinogenesis in mice. Methanolic extract at a dose of 500 and 1000 mg/kg body weight was found to be effective in decreasing the rate of tumour incidence in comparison to control and cumulative number of papillomas, tumour yield and tumour burden were also found to be reduced. The depleted level of glutathione was restored in *B. variegata* bark extract treated groups.23

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<tr>
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<td>5</td>
<td>Chemoprevention &amp; Cytotoxic effects</td>
<td>Rajkoooor B</td>
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</table>

Table no. 1: Table shows the reported activity and Model used
SUMMARY AND CONCLUSION

In the present article, we had a review on the relevant properties such as pharmacognostical, phytochemical and pharmacological information on the *B. variegata*. A critical analysis of the literature revealed that this plant contains different constituents which are responsible for various activities. The present review of literature revealed that the plant is having antidiabetic, anti-inflammatory, immunomodulatory, antitumour, hepatoprotective, antibacterial, haemagglutinating, haematinic, antimicrobial, antiulcer and antitumour activities.

REFERENCES