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AN UPDATED REVIEW ON MULTIPLE PHARMACOGNOSTICAL APPLICATIONS OF *BAUHINIA VAHLII* WIGHT AND ARN

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ABSTRACT

The present study is an attempt to put an insight into a medicinal plant *Bauhinia vahlii* which is found in the Himalayas, from Kashmir to Sikkim, up to altitudes of 1500 m. *Bauhinia vahlii* is the largest creeper in India and is called *Adattige* in Telugu and *Asamantaka* in Sanskrit. This is an immense climber going over the tops of trees even the highest trees in the forest, and doing much harm on account of the shading of the growing tops of useful forest trees. *Bauhinia* species have a long history of traditional medicinal applications. It has been reported to contain amino acids, proteins, minerals and flavonoids. So far it has been screened for, antimicrobial, mild diuretic, anti-oxidant**,** and activity**.** This article is to provide an overview of the chemical constituents present in stem and bark of plant and their pharmacognostical and pharmacological evaluation**.**

KEYWORDS: Anti- diabetic, Anti-inflammatory, Traditional, Pharmacognostical, Pharmacological.

INTRODUCTION

Herbal drugs constitute a major share of all the officially recognized systems of health in India *viz*. Ayurveda, Yoga, Unani, Siddha, Homeopathy and Naturopathy, except Allopathy. More than 70% of India's 1.1 billion populations still use these non-allopathic systems of medicine. Currently, there is no separate category of herbal drugs or dietary supplements, as per the Indian Drugs Act. However, there is a vast experiential-evidence base for many of the

natural drugs. This offers immense opportunities for Observational Therapeutics and Reverse Pharmacology. Evidence-based herbals are widely used in the diverse systems and manufactured, as per the pharmacopoeial guidelines, by a well-organized industry[1] (Vaid A.D).

Leguminosae is the third largest family of flowering plants, after the Orchidaceae and Asteraceae.[2] Leguminosae family has enormous diversity as it include every morphological types of plants- viz. herbs, shrubs, small and big tree, climbers, creepers, lianes, annual, perennial etc. In economic importance, leguminosae is quite vast second to the grasses, Poaceae. It is an extremely important family provides a wide range of nutritious food, fiber, shelter, valuable medicines and also virulent poisons[3,4] and also provides much needed proteins for human body. The presence of nitrogen fixation bacteria on the root nodules is the specialty of plants belonging to subfamilies Papilionatae and Mimosae of Leguminosae increasing the efficiency of their nitrogen nutrition and benefiting soil fertility. This ability makes these plants ecologically very important. Pulse crops belonging to this family occupy a special place in agriculture and human nutrition.[5]

Certain species of *Bauhinia* genus (family; Fabaceae) have a long history of traditional medicinal uses. The dried leaves, buds and flowers of *Bauhinia tomentosa* L. are prescribed in dysentery.[6] The bark of *Bauhinia pupurea* is used as astringent in diarrohoea and flowers are used as laxative.[7] Similarly *Bauhinia forficata* is one of the most commonly used plants in folk medicine against diabetes.[8]

Bauhinia vahlii is *a* perennial creeper native to the Indian subcontinent and has been ethnobotanically used for various purposes. The leaves provide an excellent source of fodder in the Central sub-Himalaya region and are also used as a material for making a variety of wrappers.[9] The roots of *Bauhinia vahlii* are used for pulmonary tuberculosis, dysentery and fever. In some places the root of *Bauhinia vahlii* is used as a toothbrush to cure pyorrhoea and root extract for treatment of viral diseases. The leaves are used in the treatment of abrasions. The fruits are used for treatment of infertility in women and as aphrodisiac. The bark is useful for skin diseases, diarrhea and the pod are taken orally as antidiarrhoeal, anti-dysentery. The seeds are used in pimples and blisters. A paste of seeds is applied to boil and given to children suffering from indigestion.[10] The aqueous solution of the root paste of *Bauhinia vahlii* is used to treat syphilis or gonorrhea.[11] It has been reported to contain amino acids, proteins, fatty acids, minerals, lectins, protocatechuic acid, phytohemagglutinins.[12] So

far it has been screened for, antimicrobial.[13], mild diuretic[14], anti-oxidant[15], anti-diabetic[16] and anti -inflammatory activity.[17]

BOTANICAL DESCRIPTION

Figure 1: *Bauhinia vahlii.*

Bauhinia vahlii is a giant climber and one of the most abundant Indian *Bauhinia* species. Some plant grows up to 10-30m long, woody stem can as thick bark as 20cm. Leaves are alternate, petiolate, 7.5-9 cm long, broad, orbicular in shape,10-46cm long and almost as, sparsely hairy on the upper and densely hair on the lower surface 2-lobed with a broad cut.[18] Tendrils are alternate, axillary and circinate.[19]

Phytochemistry

Bauhinia vahlii has been reported to contain amino acids, proteins minerals and flavonoids from its seeds, flower and Leaves[20] (Mehta P. S and K.C Bhatt). **Seeds:** contain amino acids, lipids, essential oil, carbohydrates, **Leaves:** contain agathisflavone, betulinic acid, beta-sitosterol, kaempferol. **Flower:** contain quercitroside, isoquercitroside, rutoside, taxifoline, rhamnoside. The dried pods of *Bauhinia vahlii*, without seeds, yielded 4 new constituents, viz. methyl 4-*O*-methylgallate, methylgallate, (+)-mopanol and (+)-catechin and concentration of calcium potassium and sodium on dry weight basis in *Bauhinia vahlii* collected from Garhwal Himalayas was 42 ppm, 16.5 ppm and 2.50 ppm respectively. He also mentioned that *Bauhinia vahlii* was found to posse high sugar content during the spring season with the values in range 0.1-0.68 percent. He Stated that it has been repoted to have agathisflavone, flavonoids, betulinic acid, triterpens, campesterol, and steroids in leaves the plant is also reported to contain kaemferol, quercetine, rutin, betulinic acid, quercitrin, stigmasterole in leaves.[21] It is estimated that protein contents of 27.3% and 26.4%, both *Bauhinia vahlii* and marking nut *Semecarpus anacardium* represent an extremely good

source of protein. Both have a high fat content (*Bauhinia vahlii* 29.9% and *Semecarpus anacardium* 36.4%), and *Bauhinia vahlii* fat is rich in linoleic acid (31.0%), while marking nut *Semecarpus anacardium* contains only 14.5% of this fatty acid. *Bauhinia vahlii* and marking nut *Semecarpus anacardium* are rich in Calcium 302 and 295 mg/100 g, respectively. *Bauhinia vahlii* nut can be processed easily and is richer in polyunsaturated fatty acids; it is thus considered for public consumption[22] (Sastri B., Rama V.,).The three Indian tribal pulses, *Bauhinia purpurea*, *Bauhinia racemosa*, and *Bauhinia vahlii* for pod morphology, proximate compound., seed protein fraction, amino acid compound, minerals, and anti-nutritional factors. The seeds of *Bauhinia purpurea* and *Bauhinia vahlii* contained more crude protein and crude lipid than those of *Bauhinia racemosa*, resulting in higher energy values for these 2 pulses. The seeds of *Bauhinia purpurea* were high in K, whereas those of *Bauhinia racemosa* and *Bauhinia vahlii* were high in Ca and Fe. Albumins and globulins were the predominant seed protein fractions in *Bauhinia purpurea* and *Bauhinia racemosa*. In all species the contents of lysine, tyrosine, and phenylalanine were fairly high. The contents of S-containg amino acids were limiting. Isoleucine and leucine were limiting only in *Bauhinia vahlii* proteins. Levels of the anti-nutritional factors investigated, free phenols, tannins, L-DOPA, and hemagglutinin and trypsin inhibitor activities were not particularly high[22] (Rajaram N). Reported that the dried pods of *Bauhinia vahlii* without seeds were found to possess methyl 4-O-methyl gallate, methyl gallate, (+) - mopanal and (+) – catechin[23] (Chauhan R., 2013).

Pharmacological evaluation

Anti-oxidant potential of Bauhinia

The ability of the phenolics to act as antioxidants depends on the redox potential of their phenolic hydroxyl groups that allow them to act as reducing agents, hydrogen-donating antioxidants and oxygen quenchers.[24] As a result, antioxidants are often reducing agents such as thiols, ascorbic acid or polyphenols.[25] Antioxidant properties elicited by plant species have a full range of perspective applications in human healthcare. In recent years, the prevention of cancer and cardiovascular diseases has been associated with the ingestion of fresh fruits, vegetables or leaves are rich in natural antioxidants.[26] They also widely used as ingredients in dietary supplements in the hope of maintaining health and preventing diseases such as cancer and coronary heart disease.

Higher level of antioxidant activity in the methanol extract of *Bauhinia vahlii* leaves when compared with other tested extracts can be considered as new sources of natural antioxidants.[27] The alcoholic and aqueous extracts of *Bauhinia variegate* have shown significant antioxidant activity.[28] Tested that the antioxidant potential and total phenolics content of 70% acetone extracts of the raw and processed (dry heated, soaked and autoclaved) seeds of *Bauhinia vahlii.* The extract of raw seeds contained higher levels of total phenolics (30.8g/100g) and tannins (19.6g/100g) compared to processes seed extract. In all the models for anti-oxidant and free radical scavenging activity, except DPPH radical scavenging activity, the extract from raw seeds manifested the strongest anti-oxidant activity than that from processed seeds. Whereas, the extract from dry heated seed exhibited higher $DPPH^{\cdot}$ scavenging activity (IC_{50} 70.77 µg/mL) than the raw seeds (IC_{50} 74.4 µg/mL). This study has to some extent validated the antioxidant potential of the seeds of *Bauhinia vahlii.*[29] The phenolic content and antioxidant activities of chloroform, acetone, methanol and hot water extracts of *Bauhinia vahlii* leaves. It was found that methanol extract contains higher levels of total phenolics, tannins and flavonoids and concluded that the methanolic extract of *Bauhinia vahlii* leaves have strong antioxidant potential.[30] The antioxidant effect of flavonoids of nine species of *Bauhinia* and concluded that alcoholic and aqueous extracts of *Bauhinia variegata*. Leaf showed significant antioxidant activity in all the methods, ($P < 0.01$) for reducing power and ($P < 0.001$) for scavenging DPPH, super oxide, nitric oxide, and hydrogen peroxide radicals. It also effectively decreased plasma cholesterol, triglyceride, LDL, and VLDL and increased plasma HDL levels and may show antihyperlipidemic activity.[31] Reported that the hepatoprotective and antioxidant activities of *Bauhinia hookeri* ethanol extract (BHE) in mice against CCl_4-induced liver injury. It was found that BHE treatment along with CCl_4 for 6 weeks significantly inhibited the CCl_4-induced increase in enzymes: alanine aminotransferase (44 and 64%), aspirate aminotransferase (36 and 46%), alkaline phosphatase (28 and 42%), and malondialdehyde (39 and 51%) levels at the tested doses (500 and 1000 mg/kg/day), respectively. Moreover, BHE treatment markedly increased the activity of antioxidant parameters, glutathione peroxidase, glutathione reductase, glutathione transferase, and superoxide dismutase.[32] The total phenolics content of 70% acetone extracts of the raw and processed (dry heated, soaked and autoclaved) seeds of *Bauhinia vahlii.* The extract of raw seeds contained higher levels of total phenolics (30.8g/100g) and tannins (19.6g/100g) compared to processes seed extract. In all the models for anti-oxidant and free radical scavenging activity, except DPPH radical scavenging

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Anti-diabetic potential of Bauhinia

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by both postprandial and fasting hyperglycemia with disturbances in carbohydrate, fat and protein metabolism. Hyperglycemia in diabetes results either from an absolute deficiency in insulin secretion (type 1 DM) or insulin action (type 2 DM) or both. The incidence of diabetes has increased worldwide in recent years. The estimated number of people with diabetes was 30 million in 1985, 150 million in 2000 and then 246 million in 2007, according to the International Diabetes Federation. It expects this number to hit 380 million by 2025.[34] There is a burden of unwanted side effects like diarrhea, nausea, dyspepsia, myocardial infarction, peripheral edema and dizziness with the use of conventional anti-diabetic drugs. It is reported that about 800 plants may possess anti-diabetic potential.[35] Hypoglycemic activity of medicinal plants is due to their ability to restore the function of pancreatic tissues by causing an increase in insulin output, inhibiting the intestinal absorption of glucose or facilitating metabolites in insulin dependent processes.[36][37] Extracts/drugs that act as α-glucisidase or α-amylase inhibitor are able to reduce the blood glucose level by inhibiting the gastric enzymes which is obligatory for the break the polysaccharides in to the simple sugar. There are large number of plants which have the capability to inhibit the α-glucosidase and αamylase activity and may be used as treatment of dia- betes Type I and Type II**.**[38] In several countries and continents, there is a popular use of leaves of any species of *Bauhinia* as a mean of controlling hyperglycemia.[39] For this reason, part of the chemical investigation on *Bauhinia* has been driven by interest in finding compounds with hypoglycemic activity anti-oxidant and anti-inflammatory activity.

Anti-microbial potential of Bauhinia

Plant based antimicrobials represent a vast untapped source of medicines, hence, further exploration of plant antimicrobials needs to be done. The antimicrobial activity have been screened because of their great medicinal relevance with the recent years, infections have increased to a great extent and resistant against antibiotics, becomes an ever increasing therapeutic problem.[40] Natural products of higher plants may give a new source of antimicrobial agents. There are many research groups that are now engaged in medicinal plants research.[41][42] Silver and Bostian (1993) have documented the use of natural products

as new antibacterial drugs. There is an urgent need to identify novel substances active towards highly resistant pathogens.[43] In an effort to discover new compounds, many research groups screen plant extracts to detect secondary metabolites with the relevant biological activities. The screening of many plant extracts has shown that, higher plants represent potential sources of novel antibiotics.[44][45]

Tested the hexane, ethyl acetate and methanol extracts from *Bauhinia vahlii* roots for their antimicrobial activity against gram-positive bacteria (*Escherichia coli, Pseudomonas aeruginosa* and *Proteus vulgaris*) gram-negative bacteria (*Bacillus subtilis, Bacillus pumilus, Eneterococcus faecalis* and *Staphylococcus aureus*) and two fungi strains (*Candida krusei* and *Candida albicans*) using micro dilution methods, for the determination of minimal inhibition concentration (MIC) and the minimal microbicidal concentration (MMC). The MIC values of hexane extracts of *Bauhinia vahlii* roots were more than 250 µg/ml. MMC values obtained are two times greater than the corresponding MIC values.[46] The extract of three plants *Piper cubeba, Bauhinia vahlii, Cissus quadrangularis* are obtained by direct solvent extraction were used namely hexane, ethyl acetate and methanol method. In these methods the flakes from different patients were collected and cultured in potato dextrose broth and sub-cultured in Sabouraud Dextrose Agar and Potato Dextrose agar by swabbing and streaking method. The significant growth was observed in potato dextrose broth. Well diffusion was done to determine the anti-fungal activity of three selected plants *Piper cubeba, Bauhinia vahlii, Cissus quadrangularis* with different solvents at different concentrations (250, 500, 750, 1000) µg/ml. The activity was found to be effective in the methanol extract of *Piper cubeba*. Broth dilution assay was performed to know the minimum inhibitory concentration of *Piper cubeba*. The MIC was 100µg/mL and IC 50 was found to be 800µg/mL.[47] The extract of three plants *Piper cubeba, Bauhinia vahlii, Cissus quadrangularis* are obtained by direct solvent extraction were used namely hexane, ethyl acetate and methanol method. In these methods the flakes from different patients were collected and cultured in potato dextrose broth and sub-cultured in Sabouraud Dextrose Agar and Potato Dextrose agar by swabbing and streaking method. The significant growth was observed in potato dextrose broth. Well diffusion was done to determine the anti-fungal activity of three selected plants *Piper cubeba, Bauhinia vahlii, Cissus quadrangularis* with different solvents at different concentrations (250, 500, 750, 1000) µg/ml. The activity was found to be effective in the methanol extract of *Piper cubeba*. Broth dilution assay was performed to know the minimum inhibitory concentration of *Piper cubeba*. The MIC was

100µg/mL and IC 50 was found to be 800µg/mL.[48] (Nithya N. R.,2013) reported that the antifungal activity of seven different species of *Bauhinia* namely *Bauhinia acuminata* L., *Bauhinia variegata* L., *Bauhinia purpurea* L., *Bauhinia scandens* L., *Bauhinia vahlii*. and A., *Bauhinia racemosa* Lam, *Bauhinia malabarica* L. Where tested against four plant pathogenic fungi like *Helminthosporium oryzae*, *Fusarium oxysporum* by spore germination method and *Rhizoctonia oryzae*, *Aspergillus niger* by agar cup method respectively. The dried plant leaves were extracted with three liters of 50% of aq. ethanol at room temperature for seven days. The individual extract was filtered separately each extract was charcoalised and conducted under reduced pressure and a dark brown residual solid was obtained in each case. The residue obtained in each case was diluted and subjected to antifungal assay for locating the antifungal properties of each species.[49] Investigated that the ethanol extracts of root, bark and seeds of *Bauhinia vahlii* for their antibacterial activity against five human pathogenic bacteria. Varied degree of inhibition of test bacteria were recorded of high zone of inhibition seen in seed extract against *Salmonella typhi*. This is followed by *Vibrio cholera*, *Klebsiella pneumonia*, *Escherichia coli* a *Staphylococcus aureus*. The low zone of inhibition was observed for *Escherichia coli* in root & bark extract.[50] The extracts of ethyl acetate and acetone of *Bauhinia vahlii* were found to be most active against all studied bacterial strains such as *Bacillus pumilis*, *Bacillus lichenoformis*, *Klebsiella pneumonae*, *Listeria monocytogens*, *Pseudomonas aerogenosa*, *Salmonella typhi*, and *Staphylococcus epidermidis* were sensitive against the 125mg/ml concentration of the extract, Therefore, Minimum Inhibitory Concentration (MIC) of these two extracts was determined against the selected bacteria showing zones of inhibition ≥ 6 mm. In order to check the susceptibility of bacterial strains one ready to use antibiotic impregnated disc i.e. erythromycin was used as a positive control in order to check the sensitivity of the bacterial cultures. All of them showed clear zones of inhibition around the disc interpreting their high sensitivity towards antibiotics. In contrast to this, DMSO (99% pure) was used as a negative control .The results indicate the potential of *Bauhinia vahlii* in treating bacterial infections. Thus justifying their traditional uses in the treatment of urinary tract infection, diarrhea and food poisoning which are of infectious origin.[51] The methanol extract of *Bauhinia vahlii* and its various fractions were evaluated *in vitro* for their, antimicrobial as well as for their immune modulatory properties on human peripheral blood mononuclear cells (PBMCs). The antibacterial efficacy was investigated by agar-well diffusion method and Minimum Inhibitory Concentration (MIC) against two Gram-positive and seven Gram-negative was determined. Furthermore, the immune modulatory potential of the extracts was investigated through the MTT 3-(4,5-

dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide assay. The methanolic extract was found most effective (21 to 26mm) against *Escherichia faecalis, Staphylococcus aureus, Acinetobacter baumannii* and *Citrobacter freundii*. The (Minimum inhibitory concentration) MIC and (minimum bactericidal concentration) MBC values of methanolic extract was found 1.51mg/mL and 3.41mg/mL against *Escherichia faecalis* and *Proteus mirabilis* respectively. The results of PBMCs (immune modulatory properties on human peripheral blood mononuclear cells) Isolation and Cell Cultures showed that methanolic extract of *Bauhinia vahlii* significantly stimulated the proliferation of PBMCs (immune modulatory properties on human peripheral blood mononuclear cells)*in vitro* in a dose-dependent manner. These findings indicate that ethanolic extract of *Bauhinia vahlii* leaves showed high antibacterial activity and may be considered as an immuno modulatory agent.[52]

The phytochemical investigation led to the present of steroids, glycoside, alkaloids, fatty acids and tannins. The antimicrobial activity may be attributed to the presence of these bioactive constituents in the plant.

Anti-inflammatory potential of Bauhinia

Inflammation is a complex mechanism which consists of highly sequential events provoked by number of stimuli like pathogens, noxious mechanical and chemical agents, and autoimmune responses. The subsequent cascade of events which takes place in inflammation is characterized by various signs and symptoms like redness, swelling, heat, and pain. A regulated response protects against further injury and clears damaged tissue in physiological conditions while in pathological condition inflammation may result in tissue destruction and lead to organ dysfunction. Although it is a defense mechanism.[53] The complex events and mediators involved in the inflammatory reaction can easily be induced. All the steroidal and non steroidal anti-inflammatory drugs (NSAID's) available in market cause undesired and serious side effects during their clinical use, so studies have been continuing on inflammatory diseases and the side effects of the currently available anti-inflammatory drugs. The currently used anti-inflammatory drugs may not be useful in all cases so there is increased focus on plant research and their active constituents.[54] Traditional preparations of plant sources are widely used almost everywhere in the world to treat this disease.[55]

Bauhinia vahlii belongs to family Caesalpiniaceae is a common plant of Western Odisha. Phytochemical evaluation of the various extracts of *Bauhinia vahlii* reveals the presence of alkaloids, flavonoids, phytosterol, Phenolic compounds, and glycoside. Here anti-

inflammatory activity was performed based on the folk lore information by using the method, Carrageenan induced inflammation model for the estimation of anti-inflammatory effect. The development of oedima in the paw of the rat after the injection of Carrageenan is due to the release of histamine, serotonin, and prostaglandin.[56][57] Stem bark extracts of *Bauhinia vahlii* showed significant anti inflammatory activity. This significant anti-inflammatory effect may be due to the inhibition of any inflammatory mediators by the glycosides or steroids present in the extract.[58]

CONCLUSION

The pharmacological investigations carried out on *Bauhinia vahlii* validate the immense potential of this plant in the treatment of numerous diseases. Additional research and clinical trials are needed for the product development to strengthen the use of *Bauhinia vahlii* for the future generations.

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