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REVIEW ARTICLE

A Brief Review on Ethnobotanical and Pharmacological Studies of *Adenanthera pavonina* Lam.

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ABSTRACT

Adenanthera pavonina Lam. or munga is one of India's most important plants widely cultivated. It belongs to family Fabaceae. It is a popular Indian medicinal plant, has long been used commonly in Ayurvedic system of medicine. Adenanthera pavonina is rich in various active phyto-constituents (tannins, sterols, terpenoids, flavonoids, saponins, anthraquinones, alkaloids, and vitamins) in addition to different minerals in its leaves and seeds. The plant exhibits diverse pharmacological activities such as analgesic, anti-inflammatory, antipyretic, anticancer, anti-oxidant, nootropic, hepatoprotective, gastroprotective, anti-ulcer, cardiovascular, anti-obesity, antiepileptic, anti-asthmatic, antidiabetic, anti-urolithiatic, diuretic, local anaesthetic, anti-allergic, anthelmintic, wound healing, antimicrobial, immunomodulatory, and anti-diarrheal properties. The present paper gives an account of updated information on its phytochemical and pharmacological activities. So, the present review aims to provide comprehensive information from recognized sources on the ethnobotany, traditional uses, phytochemistry, and pharmacological efficacy of the medicinal plant, Adenanthera pavonina. These reports are very encouraging and indicate that herb should be studied more extensively for its therapeutic benefits. Clinical trials using Adenanthera pavonina for a variety of combinations in different formulations should also be conducted.

Keywords: *Adenanthera pavonina*, Ethnobotany, Fabaceae, Phytochemistry, Phytopharmacology.

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INTRODUCTION

The global demand for plant-derived goods has increased. Although there has been a lot of research into the use of medicinal plants in traditional medicine, scientific investigation and identification of active plant chemicals and their effects, there is still a lot more to learn.[1]

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Medicinal plants have played an important part in treating ailments and the development of human culture throughout history. Medicinal plants have always been at the forefront of all civilizations' cultures. Traditional remedies are abundant in medicinal plants, and modern medicines are made from them. Medicinal plants have been used to treat health problems, flavor and preserve food, and avert disease epidemics for a long time.[2]

The Fabaceae family comprises *Adenanthera pavonina*. The scientific name comprises two Greek words: aden, which implies "glands," and anthera, which means "anther."[3]

It is a valuable medicinal herb native to the 'Indian subcontinent.' Southern China and India are the only places where this species may be found.[4] *A. pavonina* is an intermediate to a big deciduous tree with a height of 6-15 m and a diameter of up to 45 cm. The leaves are bipinnate, with opposed or semi pairs of pinnae, and are green while young, turning yellow as they age. Flowers are aromatic, with a tiny, slender spike that resembles racemes petals. The seeds are red-colored and lens-shaped, with a diameter of 7.5-9 mm and a diameter of 7.5-9 mmr.[5]

A.pavonina is said to have a wide range of chemical compounds and biological activity Flavonoids, alkaloids, steroids, saponins, tannins, triterpenoids, polyphenols,

Figure 1: *Adenanthera pavonina*

anthraquinones, coumarins, glycosides, carbohydrates and lipid derivatives were discovered in phytochemical studies of different parts of this plant. Some studies have found that certain components, such as linoleic acid, oleic acid, and palmitic acid, predominate in the seed oil Several pharmacological effects of derivatives have been proven based on traditional knowledge of the usage of components of this plant, such as anti-nociceptive activity of leaf ethanol extract. Hypolipidemic effect of the aqueous extract of seeds; the antimicrobial and anti-oxidant activity of bark extracts; antifungal activity relates to antimicrobial peptides present in seeds. Several investigations on this species have contributed to a better understanding of its toxicity and have backed up its traditional usage.[6] This study aims to give information about *A. pavonina*'s botanic traditional usage, phytochemistry, toxicity, biological activity, and technical prospecting and provide insights into its possible use in the development of novel medicines open up new research avenues.

This larger perspective will be useful in determining the extent of scientific research and the species' technological potential.

Recent advances in biology's knowledge of free radicals and reactive oxygen species (ROS) have ignited a medical revolution, which offers a new era in health and sickness treatment.[7] It is strange that oxygen, which is required for life, may damage the human body in some situations.[8] The formation and activity of a collection of chemical molecules known as reactive oxygen species (ROS), which have a predisposition for giving oxygen to other substances, is responsible for the bulk of oxygen's potentially harmful effects. The terms "free radicals" and "anti-oxidants" have become equivalent in contemporary explanations of disease causes.[9]

A free radical is any chemical entity capable of autonomous life that possesses an unpaired electron in an atomic orbital. Most radicals have certain characteristics due to the presence of an unpaired electron. Many radicals are unstable and extremely reactive. Whether they give or take an electron from other molecules, they behave as oxidants or reductants.[10] The most important oxygen-containing free radicals in many illness states include the hydroxyl radical, superoxide anion radical, hydrogen peroxide, oxygen singlet, hypochlorite, nitric oxide radical, and peroxynitrite radical. These are highly reactive species capable of disrupting physiologically essential components in the nucleus and cell membranes, such as DNA, proteins, carbohydrates, and lipids.[11]

External causes such as X-rays, ozone, cigarette smoking, air pollution, and industrial pollutants create free radicals and other reactive oxygen species (ROS).[8] Free radical generation occurs continually in cells due to both enzymatic and nonenzymatic activities. Free radicals are produced by enzyme activities such as the respiratory chain, phagocytosis, prostaglandin production, and the cytochrome P-450 system.[12] Free radicals are formed through nonenzymatic interactions of oxygen with organic molecules, as well as those triggered by ionizing processes. Mitochondria, Xanthine oxidase, Peroxisomes Radiation Phagocytosis, Arachidonate pathways, Ischemia/reperfusion damage, Cigarette smoke, and environmental contaminants are some internally created sources of free radicals.[13]

Free radical reactions are expected to cause increasing negative alterations throughout the body as people age. All people go through "normal" changes as they become older. However, patterns determined by heredity and environmental variables that control free radical damage are superimposed on this common pattern. At particular ages, these manifest as diseases determined by hereditary and environmental factors. Two primary causes of death, cancer and atherosclerosis, are both "free radical" diseases. Chromosomal abnormalities and oncogene activity are linked to cancer initiation and progression. Endogenous free radical reactions, such as those triggered by ionising radiation, could lead to tumour growth. The strong link between fat and oil consumption and death rates from leukaemia and malignant neoplasia of the breast, ovaries, and rectum in those over 55 years old could be due to increased lipid peroxidation.[14] Atherosclerosis may be caused by free radical reactions involving diet-derived lipids in the artery wall and serum, which produce peroxides and other chemicals, according to studies. Endothelial cell damage and alterations in the artery walls are caused by these substances.[15]

When the essential balance between free radical formation and anti-oxidant defenses is unfavorable, the word is used to describe the condition of oxidative damage that results.[15] Oxidative stress is linked to damage to a wide range of molecular species, including lipids, proteins, and nucleic acids, resulting from an imbalance between free radical generation and anti-oxidant defences.[16] Trauma, illness, heat injury, hypertoxia, toxins, and excessive exercise can all cause short-term oxidative stress in tissues. Increased radical-generating enzymes (e.g., xanthine oxidase, lipogenase) are produced in these wounded tissues. phagocyte activation, release of free iron, copper ions, or a disruption of the electron transport chains of oxidative phosphorylation, resulting in excess of reactive oxygen species (ROS). The imbalance between ROS and the anti-oxidant defense system has been related to the initiation, development, and advancement

of cancer and the negative effects of radiation and chemotherapy. Diabetes mellitus, age-related eye illness, and neurological diseases like Parkinson's disease have all been linked to reactive oxygen species (ROS).[17]

Vernacular Names[18-19]

English	False sandalwood, Crab's eyes, Coral wood, Red wood, red sandalwood
Hindi	Raktakambal, Manjadi, Anikundumani, Lopa.
Sanskrit	Kunchandana
Bengali	Rakta kambal.
Telegu	Gurivenda
Tamil	Yanai Kuntamani
Punjabi	Torki

Taxonomy[19]

Domain	Eukaryota
Kingdom	Plantae
Phylum	Spermatophyta
Subphylum	Angiospermae
Class	Dicotyledonae
Family	Fabaceae
Subfamily	Mimosoideae
Genus	Adenanthera
Species	pavonina

Distribution[20-22]

In India, it is found in Sub Himalayan tract, ascending upto an altitude of 1,200 meters in Sikkim, West Bengal Assam, Meghalaya, Gujarat, Maharashtra and South India. It is also found in Peurto Rico, Cuba, Jamaica, Trinidad, Venezuela, Brazil, Costa Rica, Honduras and Southern Florida

Tree: A medium- to large-sized deciduous tree, *A. pavonina* ranges in height from 6–15 m. It is generally erect, having dark brown to grayish bark, and a spreading crown.

Seeds: The hard-coated seeds, are lens-shaped, vivid scarlet in color, and adhere to the pods. The seed coat is smooth, shiny, bony and very hard and generally has no fracture lines.

Pods: The leathery pods are curved and twisted upon dehiscence to reveal 8-12 showy seeds. Leaves: The leaves are bipinnate. They are dark green in upper surface and blue-green in lower surface. They become yellow with ageing.

Bark: The bark is dark brown or grayish-brown on the outer surface and grayish white on the inner surface. It is rough on old trees with longitudinal fissures.

Flowers: The small, yellowish flower grows in dense, drooping rat-tail flower heads. They are small, creamy-yellow in color, and fragrant. Each flower is star-shaped with five petals.

Wood: The wood is red in color and extremely hard. It is durable and used for building purposes. It is also used in making furniture.

Phytochemistry

The leaves contain octacosanol, dulcitol, betasitosterol glucosides, flavones, and stigmasterol[23-25], and the alcoholic extract of the leaves contains an alkaloid, according to previous phytochemical research. Apart from stigmasterol glycosides, the bark contains butein, chalcone, dihydromyricetin, 2, 4-dihydrobenzoic acid, robinetin, and saponins were hydrolyzed and methylated to produce methyl echinocystate and methyloleanolate. The flavones, robenetin, chalcone, butein, and flavones are all found in the wood. Methylene glutamine, a non-protein amino acid, and traces of ethledine glutamic acid are found in the seeds (Table 1).[25]

It is said to be high in flavanoids, particularly gallic acid, as well as terpenoids, tannins, sterols (beta-sitosterol, beta-sitosterol-3 –D-glucoside), triterpinoids (nonacosane and hentriacontane), and saponins (sapogenins).[26] Phytochemical investigations suggest that glycosides, saponins, and steroids are present in the seed and pod. The soluble methanol component of A. Pavonina yielded pavonin, a novel five-membered lactone ring complex.[27]

Several methoxy flavonol glycosides have been found, including kaempferol-3-O—dirhamnopyranosyl (1‴2″,1‴6″). quercetin, —glucopyranoside 3-O-dir-hamnopyranosyl-(1‴2, 1‴6) Isovitexin, quercetin-3-O-rhamnopyranosyl (1‴2″), —glucopyranoside-4′-methoxy quercetin-3-O-glucopranoside-4′-O-rhamnopyranoside, kaempferol-3-O-rhamnopyranosyl (1‴ 2″) -glucopyrano-side, quercetin-3-O-rhamnopyranosyl (1″4″) —glucopy-ranoside, quercetin-3-O-glucopyranoside, kaempferol, and quercetin derived from A. Pavonina leaf extract.[28]

O-acetylethanolamine, an active anti-inflammatory ingredient found in the seed, is present. Octacosanol, dulcitol, betasitosterol glucosides, and stigmasterol are all found in the leaves. Stigmasterol glucoside is found in the bark. HCN-glucoside, lignoceric acid, dulcitol, stigmasterol, stigmasterol glucoside, and polysaccharide are all found in the seeds. Galactomannans and polysaccharide can be found in abundance in seeds.[29]

Robinetin, chalcone, tanins, flavonoids, terpenoids, saponins, alkaloids, steroids, butin and flavonal ampelopsin, stigmasterol glucosides, oleanolic acid, echinocystic acid, sapogenins, and many more bioactive phytoconstituents have all been found in previous phytochemical investigations on this plant.[30-32]

The structures of nine compounds isolated from a 95%ethanol extract of *A. pavanina* stems and leaves were revealed as aridanin (1), 3-[(2-Acetamido-2-deoxy-beta-D-glucopyranosyl)oxy] (2), (+)-pinitol (3), sucrose (4),

Table 1: Phytoconstituents present in *Adenanthera pavonina*

Sr. No	Plant part	Phytoconstituents	Reference
1	Leaves	Niazirin and Niazirinin – nitrile glycosides,4-[(4'-O- acetylalpha- L- rhamnosyloxy) benzyl isothiocyanate, Niaziminin A, and Niaziminin B, three mustard oil glycosides, niaziminin, a thiocarbamate,4- (alpha-1- rhamnopyranosyloxy)-benzylglucosinolate, quercetin-3- O-glucoside and quercetin-3-O-(6''- Malonyl- glucoside),Niazimicin. Pyrrole alkaloid (pyrrolemarumine 400-O-a-L-rhamnopyranoside) and 40- hydroxyphenylethanamide(marumoside A and B) 4.alpha and gamma-tocopherol.2	[25]
2	Seeds	amino acid viz. arginine, cystine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, tyrosine and valine γmethylene glutamic acid, γ-methylene glutamine & traces of γ-ethylendine glutamic acid. The kernels contain pale yellow fat. The fatty acid presents are palmitic, stearic, arachidonic, lignoceric, eicosenoic. The kernels also contain stigmasterol and its glycoside, dulcitol and a polysaccharide. Oleanolic and echinocystic acid. Octacosanol, dulcitol, glucosides of β-sitosterol and stigmasterol. The dried powdered leaves of A. pavonina were successively extracted with petroleum ether, chloroform and methanol. From the chloroform extract, the hydrocarbon nonacosane & hentriacontane, the triterpenoid squalene, and the long chain fattyacid ester palmitate have been isolated. The methanolic extract yielded β-sitosterol, β-sitosterol-3β -D- glucoside.	[25]
3	Bark	Very few compounds like as stigmasterol gluco- sides, oleanolic acid, and echinocystic acid have been reported from the bark part,	[25]

(-)-butin (5), apigenin (6), isoliquiritigenin 4-methyl ether (7), oleanolic acid (8), daucosterol (9).[33]

After separating the hexane and ether soluble fractions, the alcoholic extract of the roots generated a semi-solid that frothed profusely when shaken with water. After purification, the crude product yielded a saponin, which yielded a variety of genin acids after acidic hydrolysis. The saponin's sugar moiety was shown to be glucose exclusively.[34]

The reducing sugar (1.01%) glucose was discovered in the bark of Adenanthera pavonina Linn. Aspartic acid (0.10%), threonine (0.24%), serine (0.08%), glutamic acid (0.52%), glycine (0.09%), alanine (0.07 percent), valine (0.10%), methionine (0.13 percent), isoleucine (0.06%), tyrosine (0.27%), histidine (0.11%), lysine (0.88 percent), arginine (0.88% (0.25%). The fatty acid makeup was discovered to be 5.23% lauric acid, 38.16% palmitic acid, 6.29% oleic acid, and stearic acid (8.93%).[35]

TRADITIONAL USES

A. pavonina has been used as a traditional herbal medicine to treat many ailments, including boils, inflammations, blood disorders, arthritis, rheumatism, cholera, paralysis, epilepsy, convulsion, spasm, and indigestion.[36,37] The seeds were decocted and administered externally to treat lung infection and chronic opthalmia. Because raw seeds are harmful, they may need to be boiled to remove the toxins. The crimson, glossy seeds are utilized in the manufacture of toys and jewelry, and were once used to weigh gold, silver, and diamonds due to their limited weight range, with four seeds equaling around one gramme.[38] the plant's leaves and bark are used to treat chronic rheumatism and gout, haematuria, haematemesis, ulcer and diarrhea.[39,40] Tannin or Red dye has been used to dye clothes and by the Brahmins of India to mark the forehead.[38]

Ethnopharmacology

Various components in traditional medicine have used *A. pavonina* to treat asthma, boils, diarrhoea, gout, inflammations, rheumatism, tumours, and ulcers, as well as as a tonic.[41] The plant can also be used to treat a sore throat.[42] Traditionally, the ground seed has been used to cure boils, inflammation, blood problems, arthritis, rheumatism, cholera, paralysis, epilepsy, convulsion, spasm, and indigestion, among other maladies.[41]This plant seeds have been discovered to be useful in the treatment of cardiovascular problems in pregnant women.[43] The seeds are decocted and administered externally to treat respiratory ailments and chronic ophthalmia. Blood pressure was reduced by a methanolic extract of the seeds and roots.[42]

A. pavonina seeds are used as a poultice, and powdered seeds are administered externally to speed suppuration, treat boils, and reduce inflammation. Seeds are edible, however, they are poisonous. It can also help with cholera and paralysis in general.[44] Traditionally; the ground seed has been used to cure boils, inflammation, blood problems, arthritis, rheumatism, cholera, paralysis, epilepsy, convulsion, spasm, and indigestion, among other maladies.[45-48]

According to previous reports, the bark and leaves are astringent, vulnerary, aphrodisiac and are used to treat ulcers, pharyngopathy, vitiated vata, gout, and rheumatism. Chronic rheumatism, gout, haematuria, haematemesis, and diarrhea are all treated using the plant's leaves and bark.[49] Chronic rheumatism, gout, haematuria, haematemesis, and intestinal bleeding are treated using decoctions of leaves and bark. In addition, the leaves and bark are used to treat sprains and snake bites. The leaves are also used as an astringent and as an atonic to treat diarrhea and dysentery.[50] It is also said that heart wood is astringent, aphrodisiac, and hemostatic,

and that it can help with dysentery, hemorrhages, and vitiated vata and gout. Roots are utilized in this recipe as emetic and purgative.[51]

PHARMACOLOGICAL ATTRIBUTES

Antibacterial Activity

Three thai medicinal herbs were tested for antibacterial efficacy against Campylobacter jejuni and other food-borne infections. The disc diffusion experiment optimized the methods and solvents used to extract active components. By using broth microdilution, minimal inhibitory and bactericidal concentrations were found. The most active extract against Campylobacter jejuni was *A. pavonina*, which contains flavonoids, terpines, and tannins and inhibited growth at 62.5-125 microgram/mL.[52]

Three solvent extracts of Adenanthera pavonina and Mussaenda philippica were tested on microorganisms taken from a dairy cattle rearing facility for antibacterial and antifungal activities. These crude extracts have antibacterial activity against Salmonella enteritidis, Klebsiella pneumoniae, Bacillus subtilis, Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa, indicating that they can be used as anti-infection agents in dairy cattle rearing units to prevent infections, particularly in calves who are susceptible to infections at birth.[53]

Antifungal Activity

Peptides isolated from Adenanthera pavonina seeds were tested for antifungal efficacy. Chromatography was used to extract and fractionate peptides. Candida albicans and Saccharomyces cerevisiae were examined for activity.[54]

Anthelmintic Activity

The antihelmintic properties of Adenanthera pavonina crude bark extract were investigated. When compared to the standard medicine piperazine citrate, phytochemical analysis of the crude extracts revealed the presence of flavonoids as one of the chemical constituents with considerable anthelmintic activity at 25, 50, and 100 mg/mL.[55]

Antihypertensive Activity

The impact of Adenanthera pavonina seed extract on blood pressure in normotensive rats was studied. Over a 4-weeks period, 12 adult male wistar rats were separated into three groups of four animals each and fed orally normal saline (control group), propranolol (positive control, given at 1-mg/kg), and 200 mg/kg seed extract. Seed extract was found to have the capacity to reduce blood pressure in the study.[56]

Anti-inflammatory Activity

In animal models, a methanol extract of the seeds of Adenanthera pavonina was tested for anti-inflammatory effects. The extract (50-200 mg/kg) inhibited carrageenan-induced paw edema in rats and acetic-acid-induced vascular permeability in mice in statistically significant (P 0.05) ways. Pleurisy caused by carrageenan was also suppressed at doses of 100 and 200 mg/kg.[57]

An ethanol extract from the leaves of *A. pavonina* was assessed for anti-inflammatory activity at doses of 250 and 500 mg/kg for anti-inflammatory effects using both acute and chronic inflammatory models. The dosages were shown to have anti-inflammatory properties in the acute phase of inflammation, as evidenced in carrageenan-induced hind paw edema and a subacute investigation of cotton pellet-induced granuloma development.[58]

The anti-inflammatory effect of extracts from the barks of Adenanthera pavonina was tested in a carrageenan-induced rat paw edema model at doses of 200 and 400 mg/kg body weight, with diclofenac sodium as a positive reference standard. At doses of 200 and 400 mg/kg, respectively, the PE fraction inhibited paw edema by 25.6 and 27.8%, at the first hour of the research. The anti-inflammatory effect of extracts from the barks of Adenanthera pavonina was tested in a carrageenan-induced rat paw edema model at doses of 200 and 400 mg/kg body weight, with diclofenac sodium as a positive reference standard.[59]

Adenanthera pavonina Linn. leaves were tested for anti-inflammatory efficacy using a formalin-induced rat paw edema paradigm for acute inflammation and a cotton pellet granuloma model for chronic inflammation. The anti-inflammatory efficacy of the methanolic extract and its aqueous fraction was tested at doses of 200 mg/kg and 400 mg/kg. Both demonstrated considerable effectiveness against acute and chronic inflammation as compared to the control group. Compared to the methanolic extract, the aqueous fraction of methanolic extract significantly inhibited paw edema in the acute model and granuloma formation in chronic type. Aqueous fraction of methanolic extract significantly inhibits the paw edema in the acute model and granuloma formation in chronic model with respect to the methanolic extract.[60]

Antidiabetic Activity

The glycaemic regulatory properties of hot water extract of *A. pavonina* mature leaves using rats. Different doses and tolbutamide were orally administered to normoglycaemic rats. Fasting serum glucose levels were determined at hourly intervals for 4 h using standard procedures. The results showed an extract of leaves possesses significant ($p < 0.05$) hypoglycaemic effects in both fasted and fed rats.[61]

The renal protective effect of *A. pavonina* seed aqueous extract was studied in STZ-induced diabetic rats. Extract significantly reduced proteinuria, albuminuria and lipid levels deposition in diabetic rats hence could have a beneficial effect in reducing the progression of diabetic nephropathy.[62]

The effect of an aqueous solution of leaves of *A. pavonina* on the blood glucose level of normal rats was evaluated. Oral glucose tolerance test was done to determine the glucose tolerance activity. When considering the Oral glucose tolerance test results; there was a significant decrease in blood glucose levels in the test group treated with an aqueous solution of leaves of *A. pavonina* at time 30 minutes and 120 minutes after loading 2 g/kg of glucose. There was a significantly high glucose tolerance activity in the test group compared to the control group. The study showed that aqueous solution of leaves of *A. pavonina* has the capability of regulating blood glucose level.[63]

The antidiabetic effect of galactomannans extracted from *A. pavonina*'s L. seeds in streptozotocin-induced diabetic mice was evaluated. The isolated and extracted galactomannan from *A. pavonina* was confirmed by various chemical characterization methods. galactomannans exhibited a 1.46:1 mannose: galactose ratio and high molar weight. galactomannans didnot interfere on food intake or body weight, although it increased water intake.[64]

Anti-diarrheal Activity

To anti-diarrheal potential of *Adenanthera pavonina* seed aqueous extract investigated in experimental animals against castor oil and magnesium sulphate-induced diarrhoea in rats. The effect of extract on gastrointestinal transit using charcoal and castor oil induced enter pooling was assessed using Loperamide 3 mg/kg was used as reference standard. In rats, oral administration at doses 50, 100 and 200 mg/kg exhibited dose-dependent significant anti-diarrheal potential against castor oil and magnesium sulphate-induced diarrhoea. It also produced significant reduction in propulsive movement in castor oil-induced gastrointestinal transit using charcoal meal in rats when compared with reference standard Loperamide.[65]

Anti-diarrheal Activity and Acute Toxicity

In the castor oil-induced diarrhea model on rat, the methanol extract of A. pavonina bark has significantly reduced the cumulative wet fecal mass in dose-dependent protection. At the doses of 500 mg/kg body weight found 17.91% reduction and at 1000 mg/kg body weight found 34.32% reduction compared to the control. The elements N, P, K, S, Ca and Mg were found to be the highest amount of the powdered bark sample.[66]

Anti-nociceptive Activity

The anti-nociceptive activity of ethanol extract of leaves of *A. pavonina* was investigated using various nociceptive models induced thermally or chemically in mice including hot plate and tail immersion test, acetic acid-induced writhing, and glutamate and formalin-induced licking tests at the doses of 50, 100, and 200mg/kg body weight. The result demonstrated that extract produced a significant and dose-dependent increment in the hot plate latency and tail withdrawal time. It reduced the number of abdominal constrictions and paw lickings induced by acetic acid and glutamate respectively. Plant inhibited the nociceptive responses in both phases of formalin test.[67]

Antihyperlipidemic Activity

The effect of *A. pavonina* seed extract on the blood cholesterol level of atherogenic diet rats was evaluated. Aqueous extract of the seeds of *A. pavonina* is relatively more antihypercholesterolemic than antitriglyceridemic. The methanol extract of the seeds of *A. pavonina* on rats showed that the extract caused a significant decrease in serum cholesterol and triglyceride levels.[68]

Anticancer Activity

A decoction composed of *A. pavonina* L. and *Thespesia populnea* L. Evaluated to study cytotoxicity and anti-proliferative activity against the HEp-2 cells using Lactate Dehydrogenase release, (3-(4, 5-Dimethylthiazol-2-yl)-2, 5-diphenyltetrazolium bromide), and Sulforhodamine B. Induction of apoptosis was visualized by fluorescence microscopy stained with ethidium bromide/acridine orange dye mix. In addition, brine shrimp lethality assay showed an EC50 value at a higher concentration (1.96 mg/mL).[69]

Antidiabetic, Hypolipidemic Activity

Alloxan monohydrate induced hyperglycemic model was used to detect antidiabetic activity of aqueous and alcoholic extract of *A. pavonina* (500mg/kg) seeds. Analysis of biochemical parameters shows significant beneficial effects on lipid profile in diabetes rats i.e. reduction in total Cholesterol, Triglycerides, Low Density Lipoprotein and increasing High Density Lipoprotein significantly.[70]

Antimalarial and Anti-oxidant Activity

The antimalarial activity of the methanol seed extract of *A. pavonina* Linn investigated in *Plasmodium berghei* infected mice. In addition in vitro anti-oxidant activity of assessed using the 1, 1-diphenyl-2-picrylhydrazyl based assay. At a dose of 800 mg/kg, the crude extract exerted an antimalarial activity (92.11%) higher than that of chloroquine (88.73%). Methanol seed extract of

A. pavonina demonstrated a significant antimalarial activity but did not exert any anti-oxidant effect over the parasitized treated mice.[71]

Hepatoprotective Activity

The leaves of *Adenanthera pavonina* evaluate for the hepatoprotective action against isoniazid and rifampicin-induced liver damage. Methanolic extract of *A. pavonina* and silymarin, were found to restore the levels of anti-oxidant enzymes which could be due to the ability of the constituents in the administered compounds to scavenge reactive oxygen species.[72]

Anti-Emetic Activity

Crude methanol extracts of the leaves of *Adenanthera pavonina* L., *Peltoforum roxburghii* L, Prosopis cineraria L., and *Prosopis juliflora* DC., were evaluated for anti-emetic activity. Emesis was induced by the oral administration of copper sulfate 50 mg/kg body weight to male chicks of four days age. The anti-emetic activity was determined by calculating the mean decrease in number of retching in contrast with those of control. All extracts (150 mg/kg body weight orally) showed anti-emetic activity compared with the standard drug Chlorpromazine at the same dose. Among all the extracts, *P. juliflora* showed the highest (73.64%) and *A. pavonina* showed the lowest (50.17%) anti-emetic activity.[73]

Anti-oxidant Activity

The scavenging activity of methanolic extract of *A. pavonina* Linn leaves was evaluated to find the ability to counteract oxidative damages. Scavenging activity was evaluated by DPPH free radical and nitric oxide anion scavenging assays with ascorbic acid as standard. Total reducing power was found to be increasing with increasing doses of extract.[74]

Anti-oxidant activity of methanolic extracts of leaf and bark using DPPH scavenging activity comparison shows that leaf extract the has little higher anti-oxidant activity than the bark extract. The leaf part of the plant is more active in respect of its anti-oxidant activity than bark, though leaf part lacks flavonoids.[75]

Anti-oxidant Activity and Cytotoxicity

The anti-proliferative effect of acetone and methanol bark extracts of *Adenanthera pavonina* on three cancer cell lines using sulforhodamine-B assay and their anti-oxidant activities using 1-diphenyl-2-picrylhydazyl radical and its reducing ability was investigated. The anti-oxidant and the reducing power assay showed a significant dose-dependant activity. The anti-oxidant activity of these extracts might be one of the reasons for the anticancer potential.[76]

Antiviral Activity

The activity of sulfated polysaccharide from the *A. pavonina* seeds against poliovirus type 1 in cell cultures was evaluated using dimethylthiazolyl-diphenyltetrazolium bromide method and plaque reduction assay. The sulfated polysaccharide elicited antiviral effect in steps after virus entry into the cells with a low cytotoxicity.[77]

CONCLUSION

Medicinal plants are sources of drugs and therapeutic importance due to the presence of secondary metabolites. Due to secondary metabolites, medicinal plants are sources of medications and therapeutic value. The utilization of medicinal plants as therapeutic agents is gaining popularity. Because of its anti-oxidant, antibacterial, anti-inflammatory, hypolipidaemic, and hepatoprotective properties, Adenanthera pavonina L is a possible source of medication, according to the above review. It can also be used to treat boils, inflammation, blood problems, arthritis, rheumatism, cholera, paralysis, epilepsy, convulsion, spasm, and indigestion, among other human ailments.

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