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Review Article

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An insight of pharmacognostic and phytopharmacology study of *Adenanthera pavonina*

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ABSTRACT

Population thorough out the world makes use of medicinal plants to treat health problems. Adenanthera pavonina, popularly known as red-bead tree, is a medicinal plant traditionally used for the treatment of several diseases. A. pavonina *Linn is a deciduous tree, 18-25 m tall, bole erect and 62 cm in diameter. The plant is reported to have a wide range of biological activities, such as astringent and styptic (used in diarrhoea, stomach haemorrhage, haematuria) and anti-inflammatory (in rheumatic, gout), antioxidant and hepatoprotective action. Seeds are anticephalgic and also used for the treatment of paralysis and blood pressure. The whole plants can be extensively studied for further future prospective. We hope that the present review will satisfy the needs to information of A. pavonina both the students and scholar in a similar way.*

Key words: *Adenanthera pavonina*, anti-inflammatory, phytochemistry, biological activities.

INTRODUCTION

Adenanthera pavonina belongs to the family Fabaceae. The scientific name is derived from a combination of two Greek words *aden*,"a gland,"and *anthera*, "anther" **[1]**. *A. pavonina* commonly known as red wood and red-bread tree is a deciduous tree, 18-25 m tall, erect and 60 cm in diameter **[2]**. *A. pavonina* is a fast growing tree included in the Global Compendium of Weeds as a natural and agriculture weed **[3]**. *A. pavonina* is also known as a food tree because its seeds and young leaves are cooked and eaten by people. Also, in some countries, the seeds are roasted, elsewhere boiled, roasted and shelled before eaten with rice by children and adults **[4]**.

The *A. pavonina* has been reported to demonstrate anti-inflammatory and analgesic activities **[5-6]**, antihypertensive effect [7], antifungal **[8]**, anti-oxidant **[9]**, anticancer **[10-11]**, hepatoprotective **[12]**, renal protective **[13]**, CNS depressant and anticonvulsant **[14]**, anti hyperlipidemic **[15]** and antibacterial **[16-17]**. Their medicinal properties are due to the presence of flavonoids **[18]**, glycosides **[19]**, saponins and steroids **[20-21]**.

Fig. 1 Exomorphic features of the leaves

Vernacular names [2, 22]:

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

Taxonomy [23]:

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

Distribution:

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 **[24-25].**

Description [**25, 26**]:

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 curve and twist upon dehiscence to reveal 8-12 showy seeds. **Leaves:** The leaves are bipinnate (fig.1). 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 outer surface and grayish white in 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 colour and extremely hard. It is durable and used for building purpose. It is also used in making furniture.

TRADITIONAL USES

A. pavonina, have been used as traditional herbal medicine against a variety of diseases like:

Seeds of the plant are used for the treatment of boils, inflammations, blood disorders, arthritis, rheumatism, cholera, paralysis, epilepsy, convulsion, spasm and indigestion **[27-28]**. Decoction of the seeds were used in pulmonary infection and externally applied in chronic opthalmia. Raw seeds are poisonous so seeds may require boiling to neutralize toxicity. The red, glossy seeds are used in making toys and for jewellary, and in earlier days were used to weigh gold, silver and diamonds, because they have a narrow range in weight for e.g. four seed is equal to about one gram [**22**].

Leaves and Barks of the plant are used as a remedy for chronic rheumatism, gout, haematuria, haematemesis, ulcer and diarrhoea [**30, 26**].

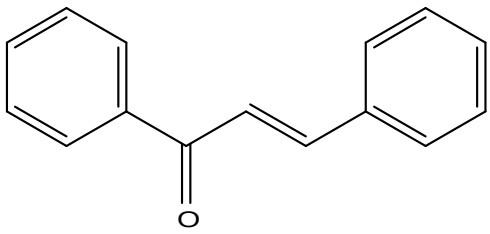
Tannin or Red dye has been used for dyeing clothes and by the Brahmins of India for marking the forehead [**22**].

PHYTOCHEMISTRY

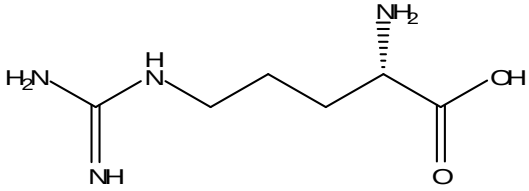
Plant parts	Phytochemicals	Reference
Seeds	amino acid viz. arginine, cystine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, tyrosine and valine γ-methylene glutamic acid, γ-methylene glutamine & traces of γ-ethylendine glutamic acid. The kernels contain pale yellow fat. The fatty 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.	**[18, 31]**.
Root	Saponin having glucose as the sugar moiety and oleanic acid and echinocystic acids as sapogenin.	
	Pavonin: A new five-membered lactone named pavonin with an exo-cyclic double bond has been isolated from the methanol soluble part of *Adenanthera pavonina.* The structure of pavonin has been established with the aid of	[**18**]
Leaves	spectroscopic techniques	[**31-32**].
Bark		[**19**].
Wood		[**33**].

Chemical constituent of *Adenanthera pavonina*

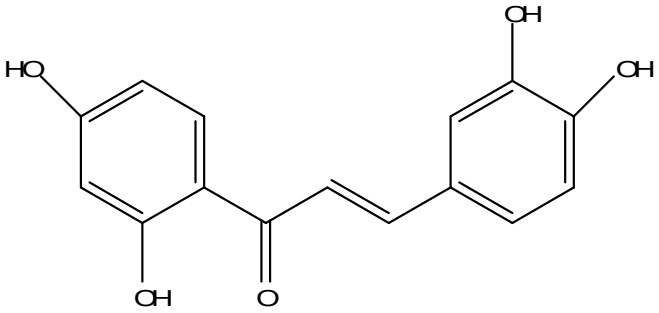
Chalcone



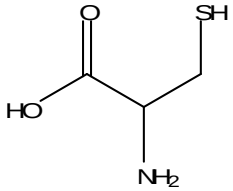
Arginine



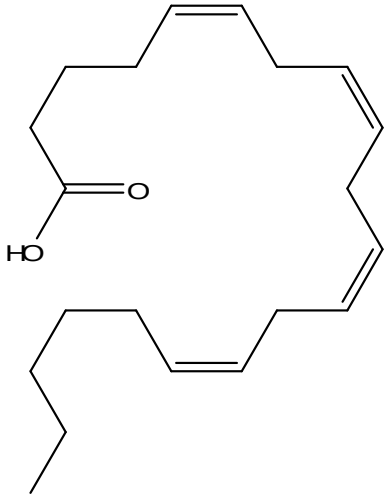
Butein {1-(2,4-dihydroxyphenyl)-3-(3,4-dihydroxyphenyl)prop-2-en-1-one}



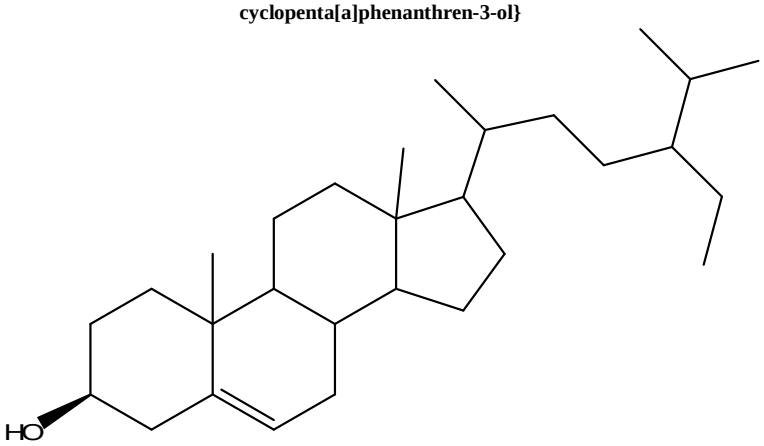
Cysteine



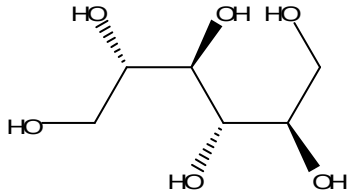
Arachidonic acid



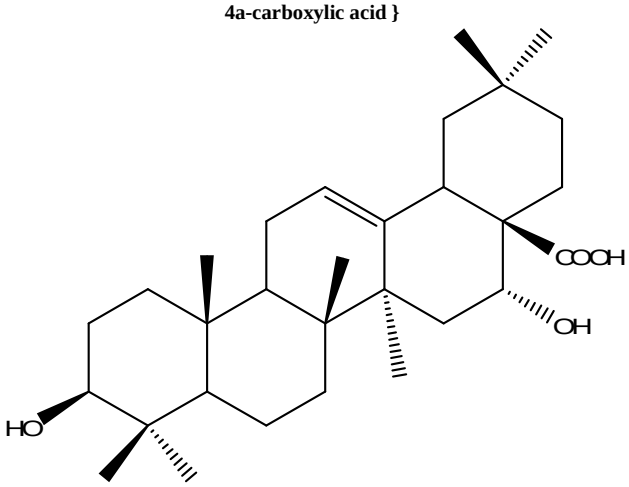
β-sitosterol{(3S)-17-(5-ethyl-6-methylheptan-2-yl)-10,13-dimethyl-2,3,4,7,8,9,10,11,12,13,14,15,16,17-tetradecahydro-1H-cyclopenta[a]phenanthren-3-ol}



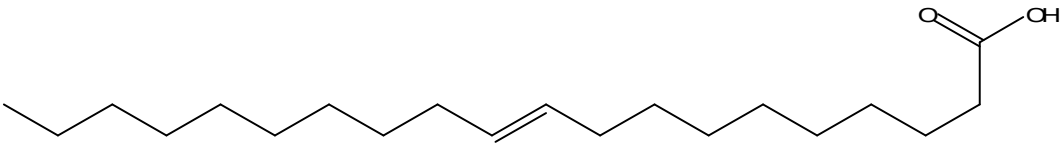
Dulcitol{(2R,3S,4R,5S)-hexane-1,2,3,4,5,6-hexaol}



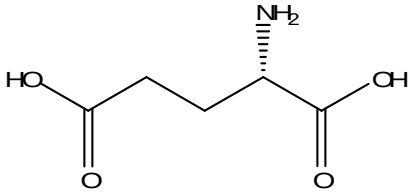
Echinocystic acid{ 5,10-dihydroxy-2,2,6a,6b,9,9,12a-heptamethyl-1,2,3,4,4a,5,6,6a,6b,7,8,8a,9,10,11,12,12a,12b,13,14b-icosahydropicene-4a-carboxylic acid }



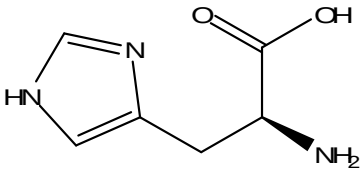
Eicosenoic acid{ (E)-icos-10-enoic acid }



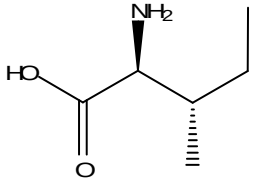
Glutamic acid{2-aminopentanedioic acid }



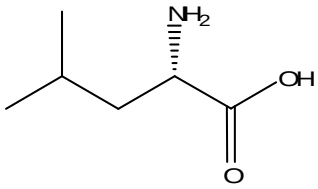
Histidine {2-amino-3-(1H-imidazol-4-yl)propanoic acid}



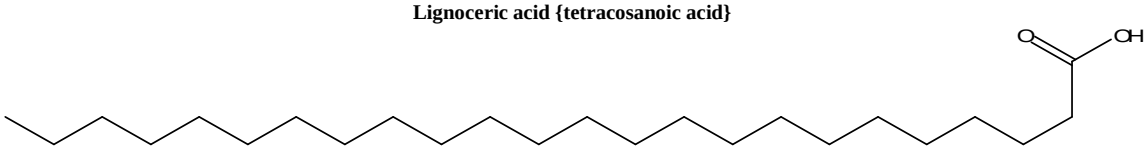
Isoleucine {2-amino-3-methylpentanoic acid}



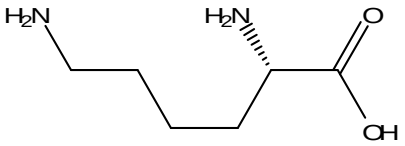
Leucine {2-amino-4-methylpentanoic acid }



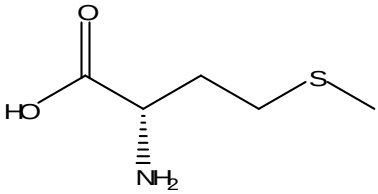
Lignoceric acid {tetracosanoic acid}



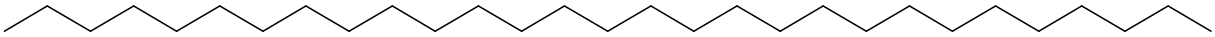
Lysine {2,6-diaminohexanoic acid}



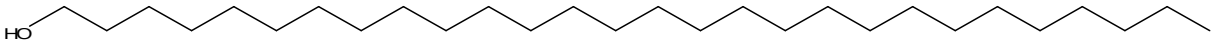
Methionine {2-amino-4-(methylthio)butanoic acid }



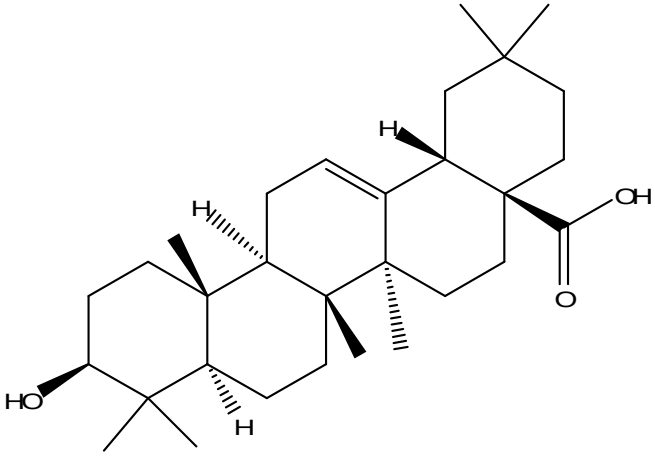
Nonacosane



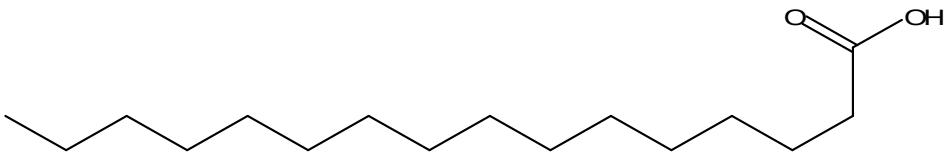
Octacosanol {octacosan-1-ol}



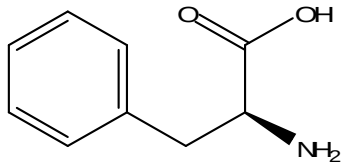
Oleanolic acid {10-hydroxy-2,2,6a,6b,9,9,12a-heptamethyl-1,2,3,4,4a,5,6,6a,6b,7,8,8a,9,10,11,12,12a,12b,13,14b-icosahydropicene-4a-carboxylic acid }



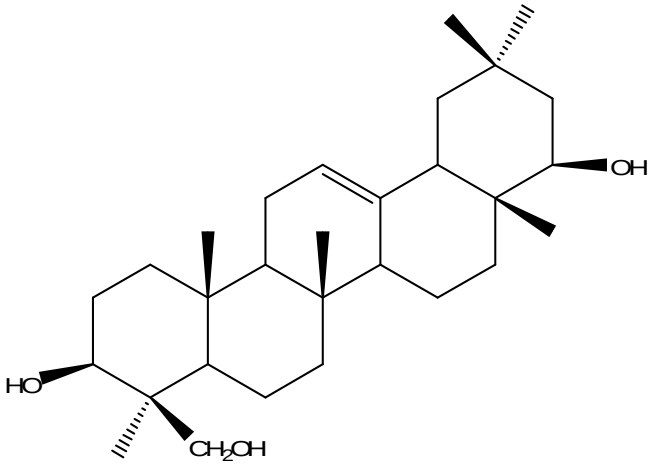
Palmitic acid



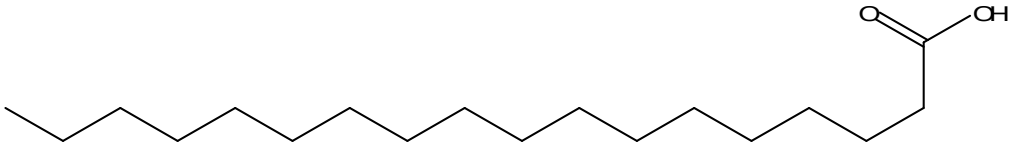
Phenylalanine{2-amino-3-phenylpropanoic acid }



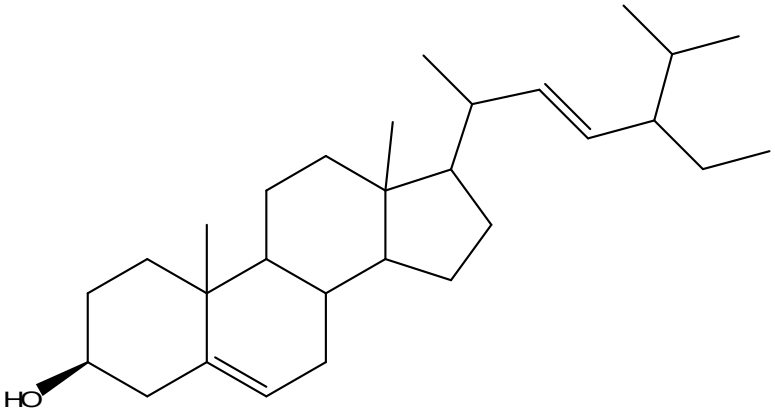
Saponin {4-(hydroxymethyl)-hexamethyl-icosahydropicene-3,9-diol}



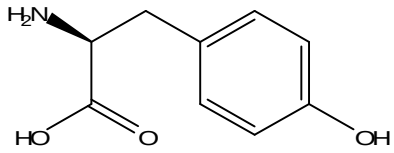
Stearic acid



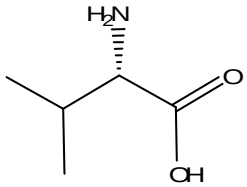
Stigmasterol{ (3S)-17-(5-ethyl-6-methylhept-3-en-2-yl)-10,13-dimethyl-tetradecahydro-1H-cyclopenta[a]phenanthren-3-ol



Tyrosine{ 2-amino-3-(4-hydroxyphenyl)propanoic acid}



Valine{2-amino-3-methylbutanoic acid}



➢ The **Oil** of *A. pavonina* L. Seeds and its Emulsions: The oil was found to be rich in neutral lipids and low in polar lipids. The neutral lipids consisted mainly of triaglycerols. Unsaturated fatty acids were found as high as 71%, while the percentage of saturated fatty acids was only 29%. GC and GC/MS analyses revealed linoleic, oleic and lignocerotic acid to be predominant among all fatty acids in the *A. pavonina* oil, whereas stigmasterol was the major steroid identified within this study. The results obtained indicate possible applications of the tested oil in pharmaceutical and medical fields as drug and cosmetic active ingredient carriers [**34**].

➢ **Physico-chemical characterization of seed oil** and nutrient assessment of *A. pavonina*, an underutilized tropical legume: The seeds of *A.pavonina* contained appreciable amounts of proteins, crude fat and minerals, comparable to commonly consumed staples. Total sugar was low while starch constitutes the major carbohydrates. It was concluded that *A. pavonina* seeds represent a potential source of oil and protein that could alleviate shortages [**4**].

TOXICITY STUDIES

Acute oral toxicity of methanolic extract of *A. pavonina* seeds in albino mice at the different doses 100 mg/kg, 200 mg/kg, 400 mg/kg, 800 mg/kg, 1600 mg/kg and 3200 mg/kg intraperitoneally. Mortality in each group was observed for 24 h. Percentage lethality was determined for each group by counting the number of dead animals per group From the acute toxicity test in which the LD50 of the methanolic extract was found to be 1360 mg/kg, it shows that the extract may be relatively non toxic when considering the amount or quantity taken under normal circumstances [**11**].

Acute oral toxicity of methanolic extract of *A.pavonina leaves* in Swiss albino mice of either sex, at the different doses 50, 300 and 2000 mg/kg body weight, they have not showed any mortality and significant changes in body weight. So it reveals the safety of these extract up to 2000 mg/kg body weight [**12**].

PHARMACOLOGICAL STUDIES

Hepatoprotective

Hepatoprotective activity studied on *A. pavonina* leaves against Isoniazid and Rifampicin induced liver damage in rats. 50% methanolic extract of *A. pavonina* used as hepatoprotective at doses of 100 and 200 mg/kg and silymarin 100 mg/kg used as standard drug for 28 days. The serum levels of glutamic oxaloacetic transaminase (SGOT), glutamate pyruvate transaminase (SGPT), alkaline phosphatase (ALP), bilirubin, total protein, albumin and lactate dehydrogenase (LDH) were estimated along with activities of superoxide dismutase (SOD), catalase, glutathione, thiobarbituric acid reactive substances (TBARS). Histopathological analysis was carried out to assess injury to the liver tissue. The methanolic extract of leaves of *A. pavonina* exhibited hepatoprotective effects against INH and RIF induced hepatic damage in rats as compared to standard drug silymarin [**12**].

Anticancer

Methanolic extract of *A. pavonina* seed and leaves has showed efficacious antimicrobial and anticancer activity against various pathogens and it is effective against bone cancer cell line but acetone seed extract has not showed biological activity [**10**].

Methanolic extract of *A. pavonina* evaluated on Dalton's ascetic lymphoma at doses of 125 and 250 mg/kg/day, p.o. Tumour was induced in mice by intra-peritoneal injection of DAL cells (1X1000000 cells/mouse). The antitumor effect of the extract was evaluated by using In-vitro cytotoxic assay; Mean survival time (MST), Tumour volume (TV), Percentage Increase in Life Span (ILS), viable and non-viable tumour cells count. The findings of this study indicate that the MAP possesses significant antitumor activity [**11**].

Anti-inflammatory and analgesic activity

Methanolic extract of seeds of *A. pavonina* was evaluated for anti-inflammatory effects in animal models at doses of 50 and 200 mg/kg body weight. The extract produced statistically significant inhibition of the carrageenan-induced paw oedema in the rat, as well as the acetic-acid-induced vascular permeability in mice. Acute toxicity studies revealed that the extract produced reduced motor activity. This study demonstrated the anti-inflammatory and analgesic effects of *A. pavonina* extract [**5**].

Anti-inflammatory and analgesic activity of *A. pavonina* evaluated at doses of 50, 100 and 200 mg/kg. Drugs were administered intraperitoneally 30 minutes later; all received intraperitoneally injections of 0.6% w/v acetic acid solution in water at a dose of 10 mg/kg. A reduction in the number of writhing as compared to the control group was considered as evidence of analgesic activity **[14].**

Jayakumari *et al.,* (2012) investigated the anti-inflammatory activity of *A.pavonina* leaves using formalin induced rat paw edema model for acute inflammation and cotton pellets model for chronic inflammation. The aqueous and methanolic extract showed significant anti-inflammatory effect at doses 200 and 400 mg/kg [**6**].

Renal protective

The renal protective effect of aqueous extract of *A. pavonina* seed at doses of 50, 100, 200 mg/kg p.o. was studied in Streptozocin induced diabetic in rats. Extract was given daily for 13 weeks. After 13 weeks of treatment, in Streptozocin induced diabetic rats, severe hyperglycemia was developed, with marked increased in proteinuria and albuminuria, and in *A. pavonina* aqueous extract treatment significantly reduced proteinuria, albuminuria, lipid levels, and glycated haemoglobin (HbA1c) deposition in diabetic rats. So, APSAE has reduced development of diabetic nephropathy in streptozocin induced diabetic in rats [**13**].

Antioxidant

Methanolic extract of *Adenanthera pavonina* Linn leaves is a potent scavenger of ROS and can counteract oxidative damages by ROS. Free radical scavenging capacity of extract MEAP was investigated by DPPH, nitric oxide and reducing power assays. The results from DPPH assay revealed that MEAP has shown efficient quenching of DPPH and nitric oxide and thus contains free radical quenching compounds which act as primary radical scavenger that react with DPPH by providing a hydrogen atom or electron donating ability. MEAP showed high IC50 values which are comparable to that of standard ascorbic acid. The reducing potential of a compound may be referred as an important marker of its possible antioxidant activity. The results of the study indicated that anti-oxidant activities of phenolic and flavonoidal compounds are responsible for the scavenging and anti-oxidant activities of methanolic extract of *A. pavonina* leaves [**9, 12**].

CNS depressant and anticonvulsant activity

CNS Depressant Studies on Methanolic Extract of *A. pavonina* Seed at doses of 100 and 200 mg/kg. At 200 mg/kg, the extract produced a greater depressant activity than the reference drug (chlorpromazine-10 mg/kg) and also offered 80% protection against leptazol induced convulsion in mice. A dose dependent reduction in spontaneous locomotors activity indicating a CNS depressant effect in mice was also exhibited by the extract [**14**].

Antifungal activity

Peptides of *A. pavonina* seeds efficiently inhibited the growth of the pathogenic fungi. Peptides were extracted and fractionated by DEAE-Sepharose chromatography. This fraction was later further fractionated by reversed phase chromatography, resulting in 23 sub fractions. All separation process was monitored by tricine-SDS-PAGE. Fraction H11 and H22 strongly inhibited the growth of *Saccharomyces cerevisiae* and *Candida albicans*. Fraction H11 caused 100% death in *S. cerevisiae* in an antimicrobial assay [**8**].

Antibacterial
Hussain *et al.*, (2011) evaluated qualitative analysis of phytochemicals and antibacterial activity of solvent extracts of *A. pavonina* bark. Antimicrobial activities of different solvent extracts of A. pavonina bark were tested against Gram positive and Gram negative bacterial strains by observing the zone of inhibition. The bacteria used in the study were *Pseudomonas aeruginosa, Bacillus subtilis, Enterbacter aerogenes, Staphylococcus epidermidis,* and *Salmonella typhimurium.* Ethanolic and aqueous extracts showed the highest activity against all the tested bacteria. These results were compared with the Zones of inhibition produced by commercially available standard antibiotics. The inhibitory effects of extracts are higher or very close and comparable with the standard antibiotics used [**16**].

Adeyemi *et al.*, (2015) reported antimicrobial activity of *A. pavonina* seeds. The methanolic extract was fractionated and the entire column chromatography fraction of *A. pavonina* seeds. Antimicrobial activity evaluated against different strain of *Staphylococcus aureus*. This study provides justification for the use of *A. pavonina* seeds as an antiseptic paste [**17**].

Antihypertensive
The effect of *A. pavonina* seed extract on the blood pressure of normotensive rats was evaluated at the doses of 50,100, 200 mg/kg body weight. The study showed that *A. pavonina* seed extract have antihypertensive effect. The serum biochemistry changes may suggest that the extract has a tonic effect on the kidneys and the liver and these organs play central role in drug metabolism [**7**].

Anti hyperlipidemic
A.pavonina barks used as anti hyperlipemic tested in triton and diet induced hyperlipidemic models of wistar albino rats. The ethyl acetate fraction and n-butanol fraction of ethanolic extract at 400 mg/kg dose levels inhibited the elevation in serum cholesterol and triglyceride levels on Triton WR 1339 administration rats. The extract fractions at the same dose level significantly attenuated the elevated serum total cholesterol and triglycerides in high-fat diet-induced hyperlipidemic rats. The standard dose Atrovastatin studies showed slightly better effects. The findings of the study reveals that ethyl acetate fraction and n- butanol fraction of ethanolic bark can effectively control the blood lipid levels in dyslipidaemic conditions by interfering with the biosynthesis of cholesterol and utilization of lipids [**15**].

CONCLUSION

A. pavonina constituted a number of phytochemicals, which disclose its uses for various therapeutic purposes. Pavononin and various flavonoids can be used for the treatment of various health illnes act as hepatoprotective. antihyperlipidemic, antinociceptive, antidiarrhoeal, antioxidant, anticancer, antimicrobial, inhibitor of nephrolithiasis and carcinogenesis. However attempts are required to evaluate the mechanism of actions with therapeutic activity for *A. pavonina.*

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