

Recent developments in *Actiniopteris radiata*

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ABSTRACT

Actiniopteris radiata (family: Actiniopteridaceae) is commonly used as Indian traditional medicine. *Actiniopteris radiata* has the common names of Morpankhi, Mayurishika and Peacock's tail. Traditionally *Actiniopteris radiata* is used alone or with other medicinal plants to treat a variety of ailments. The plant contains rich in tannins, flavanoids, steroids, glycosides, hydrocarbons, Coumarins, triterpenoids and phenolic compounds. The plant used in jaundice, typhoid fever, epilepsy, diarrhea, tuberculosis, etc. The plant extract also possesses different pharmacological activities such as, anti-microbial activity, analgesic activity, anti-oxidants, anthelmintic, anti-stress and anti-allergic activities. The present review could form a sound basis for further investigation in the potential discovery of new natural bioactive compounds and provide preliminary information for future research.

Keywords: *Actiniopteris radiata*, bioactive compounds, medicine.

INTRODUCTION

The history of herbal medicine beginning from the ancient human civilization [1], man has familiarized himself with plants and used them in a variety of ways throughout the ages. In search of food, man began to differentiate those plants suitable for alimentary purpose from others with definitive pharmacological action [2]. The use of plants as herbal medicines is as old as human civilization and number of the ancient medicinal systems

such as Ayurveda, homeopathy, naturopathy, siddha, unani and other alternative medicinal systems has been utilizing plants as effective source of medicines to cure many diseases [3]. Herbal medicine, as an alternative to synthetic drugs, have played an important role at the level of basic, public health care in various countries, especially in Asia. During the previous several years, number of various natural products from plants has been characterized as useful as pharmaceuticals or nutraceuticals, due to this number of the herbal medicine have drastically increased in market availability and public usage worldwide [4]. In a report of World Health Organization (WHO), medicinal plants would be the best source to obtain a variety of drugs. It is reported that more than rocky crevices 400, 000 plant species of tropical origin have medicinal properties. About 80 % of individuals in developed countries are using traditional medicine, of plant origin and the natural product for their health due to minimal side effect and cost effective Therefore, in Current research by major pharmaceutical companies such plants should be investigated to understand their properties, safety and efficacy and for a search of new potent activity [3,5,6]. *Actiniopteris radiata* is a tiny terrestrial fern found throughout India. It is also called as Peacock's tail. It is of limited distribution, and in areas where it occurs is restricted to depleted walls and of steep slopes of exposed hilly areas, up to the altitude of 1200 m above msl. *Actiniopteris radiata* (Sw.) Link. Belonging to *Actiniopteridaceae* family is an herb with great medicinal value. According to Ayurvedic texts

Mayurashikha (*A. radiata*) is used as astringent, anti-inflammatory, tonic to genitourinary tract, alleviates vitiated blood, indicated in cough, bronchitis, asthma, diarrhea, dysentery, dysuria, Antihistaminic and Anticholinergic Activity, used internally as well as externally for infected wounds, ulcers, erysipelas, *A. radiata* has been reported to possess anti-helminthic and styptic property [3,4,7,8].

Geographical distribution

Actiniopteris radiata belonging to family (*Actiniopteridaceae*) is a tiny terrestrial fern, commonly known as Peacock's tail. It is an important medicinal plant widely distributed throughout India and also in Burma, Sri Lanka, Afghanistan, Iran, Arabia, Yemen, South Eastern Egypt, Tropical Africa, Australia and Madagascar. It is of limited distribution, and in areas where it occurs, is restricted to depleted walls and rocky crevices of steep slopes of exposed hilly areas, roadside, up to the altitude of 1200 m [9]. Black or reddish gravelly soil is best suited for its growth.

Morphology of *Actiniopteris radiata*

The Small xerophytic plant is 8-25 cm high rooting in the crevices of rocks or in between in the joints of bricks walls in most and rocky soil long roadside usually in lime rich/alluvia soil. The rhizomes is oblique to horizontal, 1.5 to 2.0 cm in length, densely covered with wiry roots, palaeae and leaf bases The young leaves show cricinate venation but the lamina becomes flat at an early stage of development.

Table: Scientific Classification and Local names of *Actiniopteris radiata*

Scientific Classification: [1,10]	Local names:[1,7]
<ul style="list-style-type: none"> • Kingdom: Plantae - Plants. • Phylum: Magnoliophyta- Flowering. • Class: Magnoliopsida - Dicotyledons. • Order: Malpighiales. • Family: Actiniopteridaceae. • Subfamily: Euphorbioideae. • Synonym : <i>A. australis</i> (L. f.) Link. <i>A. radiata</i> (Sw.) Link. <i>A. dichotoma</i> Kuhn. • Tribe : Euphorbieae. • Genus : <i>Actiniopteris</i>- Linnaeus, 1753. • Specific epithet: <i>radiata</i>. • Botanical name: <i>Actiniopteris radiata</i> 	<ul style="list-style-type: none"> • Hindi- Morpankhi. • Sanskrit - Mayurishika , Madhuchhadaa, Sahastrahi, Vahrishikhaa. • Telugu- Nemaliadugu. • Tamil-Mayilatumshikhai. • English- Peacock's tail.



Fig.No.1 Whole plant of *Actiniopteris radiata*

The laminae are fan-like, stiff and rough to touch. The sporangia are sub-marginal on an inter-marginal vein covering almost the entire biaxial surface of dichotomously segment [11, 12].

Ethno-medical uses

Whole plant paste is directly applied on cuts surface and wounds: past with sugar is given to kill intestinal worms twice for 3 days. The plant paste with sugar candy is given as a cooling agent in case of syphilis .The paste of two fronds is given daily two times a day to children to cure rickets. The whole plant paste mixed with cow's milk is given for the treatment of piles and leucorrhoea. In milk is given twice a day for 2-3 days. In case of epilepsy, plant paste with sugar candy is given[1]. 5-6 leaves paste with sugar is also given two times a day as an aphrodisiac, also used as tonic to increase the potency[11].The whole plant is also use for the treatment Typhoid[13]. The Fresh paste/dried powder of leaves (5-6) with 1 tsp. honey is given twice a day for the treatment of leucorrhoea and also increase fertility. The paste of 5-6 leaves mixed with fresh cow milk (nearly 200ml) is taken for a week or so, to overcome irregularly in menstrual period. The leaves or leaves ash (approx. 2-3 g) of the plant mixed with fresh cow milk (200 ml) is given to a lady for fortnight after menses for conception. On the other hand the paste of 8-10 leaves mixed with thin curd (nearly 250 ml) is given for birth control. Paste with sugar is used orally for twice a day, as strength tonic to increasing the potency in women [14,15,16]. Plants are dried and one tea spoonful powder is taken orally, once a day for four days in the case of cough. Plants are soaked overnight in a glass of water and

taken orally in morning for control of blood pressure and decoction of leaves is also used in tuberculosis .The whole plant is also use for the treatment asthma, fever, leprosy and hair growth. The juice extracted from the stem is taken orally twice a day to treat diarrhea[17,18].

PHYTOCHEMICAL:

Several chemicals have been identified from *Actiniopteris radiata* plant are known to be alkane hydrocarbon chains (hentriacontane, hentriacontanol) and flavonoid glycoside (quercetin-3-rutinoside) (Rutin) ,steroidal compounds (β -sitosterol, β -sitosterol palmitate, β -sitosterol-D-glucoside)[19] .glycosides are (2-(3, 4-O - Diglucos cinnamoyl) - 4 - hydroxyl furan and 1-Heptaloyl, 8-hexyl, 3-(O - diglucos), 10 - methyl, 9. 10 - dihydro naphthalene.)[20].The other Phytochemical are Dec-3-enyl, 2-(heptyloxy)-1-mercaptpoethyl terephthalate and 1-(Phenylethylbutanoate ether), 2-(3-ene heptanoate) ethane [21]. Glucose, fructose, alkaloids, Flavonoids, tannins, Saponins, Quinones, Cardio glycosides, Terpenoids, Coumarins, betacyanin and phenols [22]

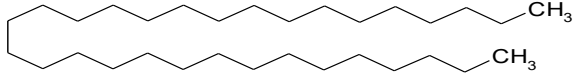
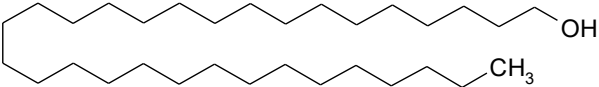
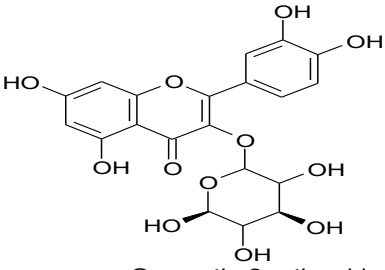
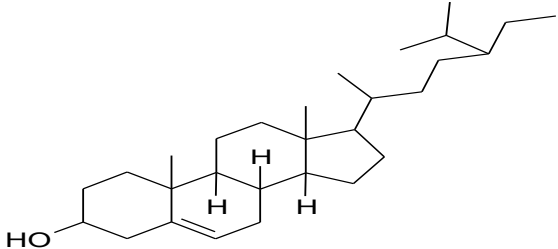
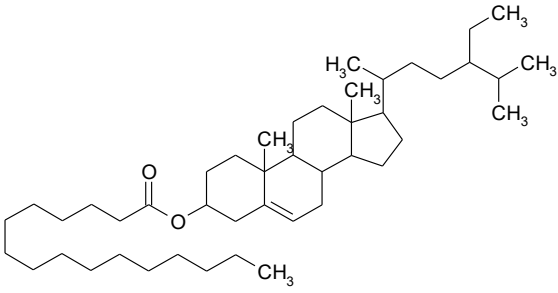
PHARMACOLOGICAL PROPERTIES

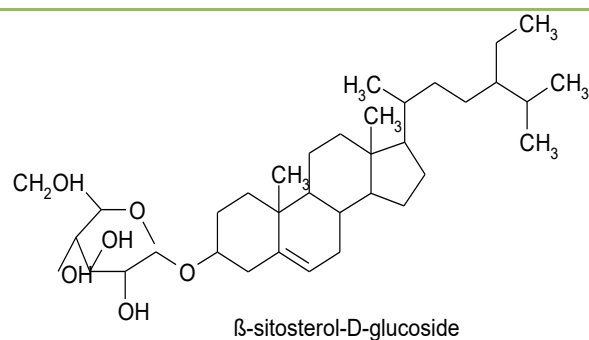
Analgesic activity:

The effect of the aqueous and ethanolic extract of plant *Actinopteris radiata* has been investigated in mice to evaluate the analgesic activity by using Acetic acid induced writhing and Tail flick method. Administration of *A. radiata* extracts shown effective analgesic activity in the Acetic acid induced Writhing

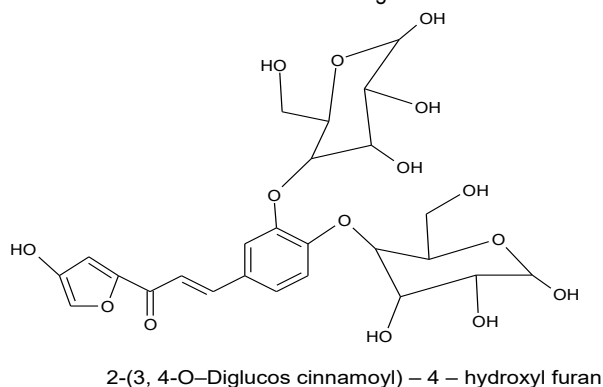
method, whereas both extracts shown non-significant analgesic activity in Tail flick method. Therefore it is indicated that both plant extracts shows only potent peripheral mediated analgesic activity and inhibits predominantly peripheral pain mechanism. The extracts have found to produce marked analgesic effect due to the presence of alkaloids, tannins, flavonoids and phenolic acid. [1]

Invitro Antihistaminic and Anti cholinergic activity:
The crude ethanolic extract *Actinopteria radiata* (Sw.) Link has been investigated to assess the spasmolytic effect on isolated rat ileum. The crude extract at a dose of 2, 4, 10 mg/ml dose dependently relaxed the rat ileum which was contracted due to the presence of agonist like histamine and acetylcholine [1,8].

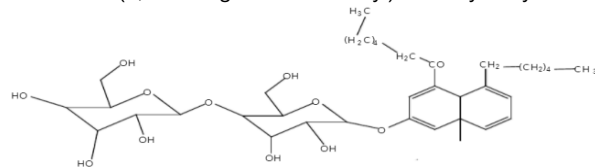
Name of compound	Structure
Alkane Hydrocarbon Chains	
<ul style="list-style-type: none"> <i>hentriacontane</i> 	 <p style="text-align: center;">Hentriacontane</p>
<ul style="list-style-type: none"> <i>hentriacontanol</i> 	 <p style="text-align: center;">Hentriacontanol</p>
Flavonoid Glycoside	
<ul style="list-style-type: none"> <i>quercetin-3-rutinoside</i> 	 <p style="text-align: center;">Quercetin-3-rutinoside</p>
Steroidal Compounds	
a) <i>β-sitosterol</i>	 <p style="text-align: center;">β- Sitosterol</p>
b) <i>β-sitosterol palmitate</i>	 <p style="text-align: center;">β-sitosterol palmitate</p>

c) β -sitosterol-D-glucoside**Glycosides**

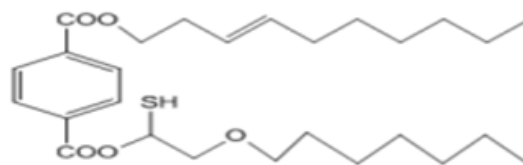
a) 2-(3, 4-O – Diglucoscinnamoyl) – 4 – hydroxyl furan.



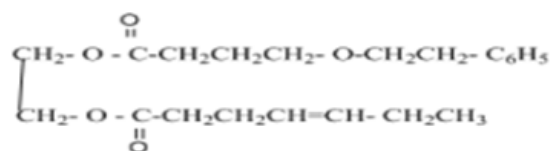
b) 1-Heptaloyl, 8-hexyl, 3-(O – diglucos), 10 – methyl, 9. 10 – dihydro naphthalene.)



c) Dec-3-enyl, 2-(heptyloxy)-1-mercaptpoethyl terephthalate



d) 1-(Phenylethylbutanoate ether), 2-(3-ene heptanoate) ethane

**Antimicrobial activity****Anti-bacterial activity**

The study was undertaken to investigate the antibacterial activity of the fern, *Actenopteris radiata* by well diffusion method. The whole plant was extracted successively with certain alcoholic and aqueous solvents (petroleum ether, chloroform, acetone, methanol and water). Different concentrations of crude extracts such as 100, 200 and 300 $\mu\text{g}/\text{mL}$ were prepared to found antibacterial activity. Chloramphenicol was used as standard drug.

The results of the shows that water and methanolic extracts of the plant had strong antibacterial activity in all the concentrations than the other solvents used. whole plant methanol and water extracts inhibits effectively the growth of the Gram-positive bacteria viz., *Bacillus subtilis* and *Staphylococcus aureus* and Gram-negative bacteria viz., *Escherichia coli* and *Salmonella paratyphii* at all concentrations (100 to 300 $\mu\text{g}/\text{mL}$) than that of other solvent extracts used Therefore, the plant extract may be used to control the diseases caused by pathogenic bacteria[3].

Antifungal Activity

Plant extract of *Actinopterys radiata* and *Caralluma adscendens* was evaluated against *Candida Albicans*, *Aspergillus niger* and *Mucor* by Cup-plate method at the concentration of 150 mg/ml and 300mg/ml using Griseofulvin used as standard drug. Diameters of the zones of inhibition were determined as an indication of activity after incubating the plates at 25°C for 72 hrs. An average of three independent determinations was recorded. The anti-microbial activity was shown significant results due to the presence of flavonoids, tannins and sterols [9].

Wound healing activity

The ethanolic extract of the *Actinopterys radiata* has been investigated to evaluate for its wound healing activity in rats. Wound healing activity was studied using Excision, Incision and Dead space wound models in rats following topical application and compared with a standard 5% w/w Povidone-iodine ointment. 10% w/w *Actinopterys radiata* ointment was prepared for topical application and 5% w/w Povidone-iodine ointment was used as a standard. On excision and incision wound models the alcoholic extract of *Actinopterys radiata* produces good wound healing activity and comparable with that of 5% w/w Povidone-iodine ointment. The alcoholic extract of *Actinopterys radiata* shown dose dependent effect on granulation tissue and hydroxyproline content. The results clearly indicated good wound healing activity [1].

Antitubercular activity

The Antitubercular activity of n-Hexane, Chloroform, Ethanol extracts was prepared from whole plant of *Actinopterys radiata* Linn was evaluated against *Mycobacterium tuberculosis* using Microplate Alamar Blue assay. Minimum inhibitory concentration (MIC) was taken to assess antitubercular activity. The minimum inhibitory concentration of n-Hexane, Chloroform and Ethanolic extracts was (12.5, 3.125, 25µg/ml) respectively and compared with Pyrazinamide (3.125µg/ml) and Streptomycin (6.25µg/ml) was taken as standard drug. The results shown that Chloroform extract has more significant antitubercular activity as compared to n-Hexane, Ethanolic extracts [23].

Antioxidant and Radical Scavenging Activity

Medicinal plants are recognized as sources of natural antioxidants that can protect biological system from oxidative stress. In this study, the antioxidative potential of different solvent extracts (n-hexane, chloroform and ethyl acetate, ethanol and aqueous) of plant *Actinopterys radiata* (Sw.) link were evaluated using different *in vitro* methods. From all the solvent extracts, ethanol extract of *A. radiata*, showed potent activity and the inhibitory concentrations of extract at 50% (IC₅₀) were 742.11, 670.80, 505.902, 372.43 and 425.23 µg/mL for DPPH, superoxide and hydroxyl radical scavenging activities, metal chelating and anti-lipid peroxidation activities, respectively and has nearly similar to that of the standard antioxidant tested. Moreover, ethanol extract of *A. radiata* showed strong reducing power, which denotes the antioxidant capacity of the extract. The results shown that the ethanolic extract of *A. radiata* is a good source of natural antioxidants [4].

The antioxidant activities of methanolic extracts of *Actinopterys radiata* and *Equisetum ramosissimum*. The analyses carried out were DPPH radical scavenging, ABTS+, reducing power. From the analyses, *Actinopterys radiata* and *Equisetum ramosissimum*, were found to have potent antioxidant activity against DPPH with the IC₅₀ value of 93.48 and 78.58 respectively. *Actinopterys radiata* had the highest values for ABTS+ radical scavenging activity (2523.11µ TE/g) and reducing power assay (0.853 absorbance at 700µg/ml)[24].

Anthelmintic activity

The Ethanol extract of whole plant of *Actinopterys radiata* Linn. has been evaluated for *in vitro* anthelmintic effect. In present study different concentration of Extract 50 mg/ml, 100 mg/ml, 200 mg/ml were investigated for its anthelmintic activity. The paralysis time [P] and death time [D] was comparable with standard Albendazole 20 mg/ml. The result indicates that the 200 mg/ml Extract possesses significant anthelmintic activity. Dose dependent effects were observed with 50 mg/ml, 100 mg/ml, and 200 mg/ml [25].

Anti-stress and anti-allergic effect

The extracts of whole plant of *Actiniopteris radiata* was screened for its therapeutic potential as an anti-allergic and anti-stress agent in asthma using specific *in vivo* animal models. Only ethanol extract at a higher dose of 100 mg/kg i.p significantly ($p < 0.05$) decreased milk induced eosinophilia by 16.20 ± 2.235 when compared with control group while even lower doses of 50 mg/kg, i.p exhibited significant inhibition ($P < 0.05$) of leukocytosis induced by milk in mice. Other extracts like petroleum ether, ethyl acetate and methanol unable to exhibit that significant potential. Results obtained thus validate the traditional claim of the *Actiniopteris radiata* utilization in different aspect of asthma due to presence of various polar secondary metabolites in ethanol extract [26]

Hepatoprotective Activity

The study has been investigated phytoconstituents, acute oral toxicity and Hepatoprotective Activity of ethanolic extract of *Actiniopteris radiata* by using CCL4 induced Hepatotoxicity in wistar albino rat. The ethanolic extract at the dose of 100,200,400 mg/kg p.o and standard drug used as silymarin 100mg/kg was administered in rat and Hepatoprotective Activity was assessed by estimating various biochemical parameters like SGPT, SGOT, ALP, serum bilirubin, followed by histo pathological studies. Ethanolic extract of *Actiniopteris radiata* at the doses of 200 and 400 mg/kg (p.o.) offered significant ($p < 0.01$) hepatoprotective activity by reducing the serum marker enzymes like SGPT, SGOT, ALP, bilirubin. Whereas at the dose of 100 mg/kg (p.o) EEAR exhibited moderate hepatoprotection ($p < 0.05$) compared with the of the standard silymarin ($p < 0.001$). Histo pathological studies of ethanolic extract of *Actiniopteris radiata* revealed that, the normal cellular architecture was retained as compared to silymarin, there by further confirming the potent hepatoprotective effect. Hepatoprotection exhibited by ethanolic extract of *Actiniopteris radiata* against CCl4 induced hepato toxicity was found to be dose dependent and significant as evidenced by the biochemical and histo pathological parameters. The protective effect of ethanolic extract of *Actiniopteris radiata* against CCL4 may be due to the presence of flavonoids, sterols, triterpenoids and phenolic compounds [27].

CONCLUSION

From the detailed literature review, it is concluded that the plant is a potential source of drugs that can be used in the treatment of different dermal ailments and disease areas. This plant is important traditional plant containing different steroidal and glucosidal compounds which can be used in skin disease treatment and owning different anti-microbial activities. A complete exploration and development work should be commenced for the preservation of *Actiniopteris radiata* and development of products for their restored fiscal and therapeutic application. Furthermore, there is a space for exploration to establish lead compounds for drug development. This evidence will be supportive for pharmacognosists, ethnobotanists, botanists and pharmacologists.

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