Review Article

Phytochemistry and Pharmacology of *Phlogacanthus Thyrsiflorus* Nees: A Review

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ABSTRACT

Phlogacanthus thyrsiflorus is a gregarious evergreen shrub which is used in several traditional medicines to cure various diseases. This plant has been known to possess antibacterial, antifungal, anti diabetic, anti-inflammatory, anti cancerous, hypolipidaemic and hepatoprotective activity. It has been also reported that different parts of the plant is use as anti-septic, insecticide and as an anti-allergic. A wide range of chemical compounds including diterpene glucoside, phloganthoside, has been isolated from *Phlogacanthus thyrsiflorus*. Phytochemical constituents isolated from the plant are flavonoids, tannins, phytosterols, phenol, glycosides, fatty acids, galacto-glycero lipid and volatile oil etc. The presented review summarizes the information concerning the botany, ethno pharmacology query, phytochemistry, pharmacological activities of the plant.

Keywords: *Phlogacanthus thyrsiflorus* Nees, Ethnopharmacology, Pharmacological, Phytochemical.

INTRODUCTION

In the last few years there has been an exponential growth in the field of herbal medicine and these drugs are gaining popularity both in developing and developed countries because of their natural origin and less side effects. Many traditional medicines in use are derived from medicinal plants, minerals and organic matter[1]. The World Health Organization (WHO) urged researchers to examine whether traditional medicines produced any beneficial clinical results[2]. Folkloric uses are supported by a long history of human experience. Numerous biologically active plants are discovered by evaluation of ethno pharmacological data, and these plants may offer the local population immediately accessible therapeutic products[3]. The World Health Organization (WHO) has listed 21,000 plants, which are been used for medicinal purposes around the world. Among these, 2500 species are found in India, out of which 150 species are used commercially on a large scale. India is the largest producer of medicinal herbs and it called as botanical garden of the world. There is a worldwide belief that herbal remedies are safer and less damaging to the human body than synthetic drugs. Therefore laboratories around the world are engaged in screening of plants for biological activities with therapeutics potential. One major criterion for the selection of plant for such a study is traditional healer's claim for its therapeutics usefulness. The traditional Indian medicinal system mentions herbal remedies for the treatment of variety of diseases. Ayurveda has emphasized importance of food in the management of diseases. Even practitioner of modern system has realized the significance of dietary items, in the form of nutraceutical elements, in the treatment of chronic diseases[4].

Phlogacanthus thyrsiflorus is a gregarious shrub which belongs to the family Acanthaceae. This plant has long orange-red tubular flowers, appearing in upright spikes at the end of branches. It is commonly known as Rangabahaka or Teeta phool in Assamese and Lal basak in Bengali and Hindi. The plants can be seen growing mostly during Dec-April and is distributed throughout the tropics and in the entire North East Region of India. Fruits and leaves are taken by the Karbi tribes of Assam after burning them as a specific treatment for fever [5]. Medicinal salt extracted from the ash of whole plant is used in cases of indigestion, gastritis, pharyngitis, cough, asthma and checked acidity. The paste of root is used in case of chronic leucorrhoea. Flowers are antidote to pox, prevents skin diseases like sore, scabies etc. It has also been used in jaundice[6]. It is very commonly used as a folk medicine in Assam. It is used as an anti-allergic. Curry prepared from aerial portion is given orally with rice once daily until cure[7]. It is also used in curing coughs and cold, chronic bronchitis, asthma and rheumatism. Different parts of the plant have been used as an anti-septic and also as a good insecticide. Leaf extract is administered orally in gout and rheumatism in Chakma community of Bangladesh[8]. Decoction of leaves is also beneficial in liver and spleen diseases[9]. There are reports on the use of different parts of the plant as anti-septic, insecticide[10] and as an anti-allergic. It is use in traditional herbal vapour therapy in Manipur to cure dry cough and pneumonia [11]. Jaintia tribe of Meghalaya uses fruit and leaf ash of *Phlogacanthus thyrsiflorus* Nees mixed in equal amount to treat fever[12]. The causation of several diseases of known and unknown etiologies such as Rheumatoid Arthritis, Cancer, Diabetes etc are due to generation of free radicals and compounds that can scavenge free radicals have great potential in ameliorating these disease processes. *Phlogacanthus thyrsiflora* Nees has prominent free radical scavenging property[13].

Phlogacanthus thyrsiflorus Nees is used in herbal recipe during 'Bohag Bihu', the main festival of Assam[14]. Fresh

extract of the leaf, 2-3 tea spoons early in the morning is traditionally use by local people of Kokrajhar District of Bodoland Territorial Council, India for treatment of diabetes[15]. The flower of the plant is eaten as vegetable by the ethnic communities of Tinsukia district of Assam, which is said to be useful in rheumatism, anaemia and cough[16].

TAXONOMY OF THE PLANT

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnolipsida

Order: Lamiales

Family: Acanthaceae

Subfamiliy: Acanthoideae

Genus: *Phlogacanthus*

Species: *Phlogacanthus thyrsiflorus*

VERNACULAR NAMES

Assam - Banheka, Titabahak, Titaphul

Garo - Ellot

Khasi - Baskabomphang, Dieng-soh-ja-buid, Dieng-soh-kajut

Mikir - Jaogan,Rambha arong

Nepal - Chua

Lepcha - Rheeom

Kumaun - Kaldona, Kawadoni

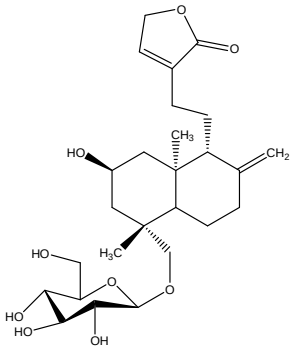
Distribution and cultivation

Phlogacanthus thyrsiflorus Nees is found usually in the sub tropical Himalayas from Ravi to Bhutan, Upper gangetic plain, Bihar, North Bengal, plains and hills of Assam at an altitude of 1200 m and Bangladesh[9]. The plant occurs as an undergrowth in moist, shady places in parts of sub-Himalayan region and in sal forests of Assam. It is gregarious and kills the vegetation beneath it. It is often cultivated as an ornamental plant for its handsome, laurel-like foliage and long spike of flowers. It can be propagated by cuttings in the rainy season[17].

MORPHOLOGY

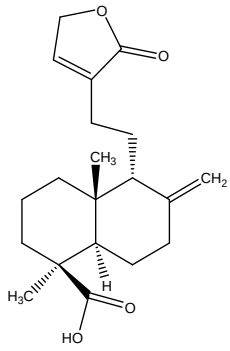
An evergreen shrub upto 2.4 m high, branchlets quadrangular, leaves are 13-35 cm long, oblanceolate, elliptic oblong, acute or acuminate, entire. Flowers are in terminal elongated, thyrsoid panicles, up to 30 cm long. Capsule is 3.8 cm long, linear clavate. In early spring the plant becomes showy with its dense cylindrical spikes of brick red velvety flower. Calyx lobe is 6.8 mm, bristly haired. Bracts are 6 to 12 mm long. Seeds are disc like. Flowering occurs in the month of February to April[18].

Figure 1: Flower, Leaf, Stem of *Phlogacanthus thyrsiflorus* Nees.



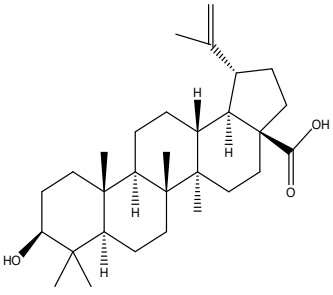
Phloganthoside

Figure 2



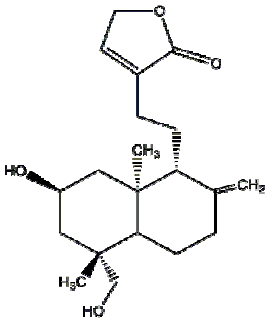
Pinusolidic acid

Figure 3



Betulin

Figure 4



Phlogantholide-A

Figure 5

PHYSICAL CONSTANTS AND NUTRITIONAL VALUES

Physical constant of the plant is calculated in percentage on dry matter basis. It was found that moisture content is 79.1 % and Ash value is 10.4 %. Nutritional value is calculated in mg /100g. Major macro nutrients present are fat (3.8mg/100g), protein (7.1mg/100g) and carbohydrate (78.7mg/100g).Micronutrients present are Sodium (2.9mg/100g), Potassium (722.9 mg/100g), Calcium (105.0mg/100g)[18]. The presence of these micronutrients is quite useful in energy metabolism as it can meet the energy requirement of the cell to some extent.

PHYTOCHEMISTRY

The leaves are reported to contain diterpene lactone, Phlogantholide, flavanoids and saponins[9,19]. A new diterpene glucoside, phloganthoside (Fig:2) has been

isolated from *Phlogacanthus thyrsiflorus* and its structure has been established as phlogantholide-A-19-*O*-β-d-glucopyranoside[20]. Another diterpene lactone Phlogantholide-A (Fig: 5) isolated from the leaves of *Phlogacanthus thyrsiflorus* has been determined as 2β, 15,18 -trihydroxy-*ent*-labd-8(17),13-dien-16-oic lactone by chemical and spectroscopic means[21]. It was found that powdered stem bark of *Phlogacanthus thyrsiflorus* on extraction with methanol and then partioned between chloroform and petroleum ether, two labdane diterpenes namely 19 –hydroxy-labda 8(17),13-diene-15,16-olide and ent-labd-8(17), 13-dien-15,16-olide-19-oic acid (pinusolidic acid) (Fig:3) and one triterpene betulin (Fig: D) were isolated[19]. Aqueous extracts of the plant show the presence of tannin, saponin, flavonoid, steroid, triterpenoid and phenol[20]. Due to presence of this phytochemicals the plant is of medicinal value.

PHARMACOLOGICAL ACTIVITIES

Hypoglycemic activity

The hypoglycemic effect was assessed by oral glucose tolerance test. The leaf and stem bark crude extract along with solvent fractions of chloroform and petroleum ether extract of stem bark of *Phlogacanthus thyrsiflorus* Nees at a dose of 100 and 200mg/kg body weight were administered orally to the different groups of *Swiss albino* mice. Reduction of blood glucose level was calculated using the same doses in hyperglycemic mice loaded with 2g/kg body weight of glucose after administration of extracts. Glibenclamide was used as reference standards at a dose of 10mg/kg body weight respectively for evaluation of hypoglycemic activity. The methanolic crude extract of stem bark and leaf showed significant (P<0.05) hypoglycemic activity at a dose of 200mg/kg body weight[24].

Anti hyperglycaemic effect of aqueous extract of the flower of *Phlogacanthus thyrsiflorus* Nees in streptozotocin (STZ) induced diabetic mice was studied. The flower extract of Phlogacanthus thyrsiflorus in doses 100 and 200 mg/kg b.w was administered for 21 days and blood glucose level, serum cholesterol, liver glycogen was estimated. Significant reduction of blood glucose level (P< 0.0001), serum cholesterol (P< 0.01) and increase in liver glycogen (P< 0.0001) was found. OGTT shows that dose 200mg/kg showed maximum improvement in glucose tolerance. The possible mechanism by which *P.thyrsiflorus* mediated its antidiabetic effect could be by improvement of pancreatic secretion of insulin from existing cells of islets[25].

Hypolipidaemic activity

The hypolipidaemic and antioxidant activities of leaves of *Phlogacanthus thyrsiflorus, Oxalis corniculata* Linn. and *Fragaria vesca* were evaluated in the study. Hyperlipidaemia was induced in rats by giving high fat diet consisting of coconut oil and vanaspati ghee, in a ratio of 2: 3 v/v at a dose of 10 ml/Kg body weight. The extracts of leaves of *Phlogacanthus thyrsiflorus*, extracts showed a significant decrease in total cholesterol, triglycerides, low density lipoprotein and malondialdehyde in blood. On the other hand catalase and superoxide dismutase were increased significantly. Ethanolic extracts of leaves of *Phlogacanthus thyrsiflorus* was found to be most effective in decreasing total cholesterol, triglycerides and low density lipoprotein and increasing high density levels[26].

Hepatoprotective activity

In this study, the hepatoprotective effect of aqueous extract of *Phlogacanthus thyrsiflorus* Nees was investigated in streptozotocin induced diabetic mice. The flower extract of *Phlogacanthus thyrsiflorus* in doses 100 and 200 mg/kg b.w was administered for 21 days and Serum Glutamate Pyruvate Transaminase (SGPT), Serum Glutamate Oxaloacetate Transaminase (SGOT), Alkaline Phosthatase (ALP) was determined.It was seen that there was a significant increase in hepatic enzymes Serum Glutamate Pyruvate Transaminase (SGPT), Serum Glutamate Oxaloacetate Transaminase (SGOT), Alkaline Phosthatase (ALP) (P<0.0001) in diabetic mice but after the administration of the flower extract the enzymes levels reduced significantly[25].

Anti-nociceptive activity

The antinociceptive activity of the *Phlogacanthus thyrsiflorus* extract was assessed by the acetic acid induced writhing method[17]. The leaf and stem bark crude extract along with solvent fractions of stem bark of *Phlogacanthus thyrsiflorus* Nees at a dose of 100 and 200mg/kg body weight were administered orally to the different groups of *swiss albino* mice and the percent inhibition of writhing was calculated. Diclofenac Na was used as reference standards at a dose of 10mg/kg body weight respectively for evaluation of antinociceptive .All the extracts showed highly significant antinociceptive activity at both of the doses. But percent inhibition of writhing was higher at the dose of 200 mg/kg body weight. The most potent antinociceptive activity was obtained with the leaf crude extract and the petroleum ether fraction with an inhibition of writhing response 78.87% and 77.46% respectively at a dose of 200mg/kg body weight. The bark crude extract and the chloroform fraction also showed significant antinociceptive activity with inhibition of 64.97% and 67.6%. The order of antinociceptive activity at a dose of 100mg/kg body weight of the extracts was as follows: leaf crude extract>petroleum ether>chloroform>bark crude extract[24].

Antioxidant activity

Malondialdehyde (MDA) is considered as an important indicator of lipid peroxidation which may be due to enhanced production of Reactive Oxygen Species (ROS). The antioxidant enzymes mainly superoxide dismutase (SOD), Catalase are first line defence against free radicals. The present study showed that the leaf extracts of *Phlogacanthus thyrsiflorus,* significantly decreased MDA

levels and increased antioxidant enzymes SOD and catalase in serum, which in turn stopped the oxidative damage due to hyperlipidaemia. The ethanolic extracts decreases the oxidative stress thereby prevents the generation of free radicals and decreases the development of atherosclerosis[26].

Analgesic activity

It was seen that ethanolic extract of the leaves of *P. thyrsiflorus* produced significant analgesia both centrally and peripherally. The central analgesic activity was tested by tail flick method in Albino rats. The peripheral analgesic activity was tested by glacial acetic acid–induced writhing test in Albino mice. The ethanol extract of *P. thyrsiflorus* had significant central and peripheral analgesic action analgesic activity as compared to control. Pretreatment with naloxone significantly decreased the reaction time producing hyperalgesia while combined treatment consisting ethanol extracts of *P. thyrsiflorus* (500 mg/kg, p.o.) and naloxone (1 mg/kg, sc) produced significant decrease in tail flick latency at 60 min as compared to the test drug alone. Naloxone blocks the actions of endogenous opioid peptides. It blocks placebo, acupuncture and stress induced analgesia: showing the involvement of endogenous peptides in these. It was seen that naloxone partially blocked the action of the test drug. This indicates the involvement of endogenous opioid peptides in the mediation of antinociceptive response of *P. Thyrsiflorus*[27].

Antibacterial activity

It is seen that ethanolic extract of *P. thyrsiflorus* was evaluated for antibacterial activity against various pathogens tested here in. The *in vitro* antibacterial activity of plant extract was determined against four pathogenic bacterial strains using disc-diffusion method using Muller-Hinton agar media. The result was compared with standard antibacterial antibiotic Ciprofloxacin (5µg/ ml). Minimum inhibitory concentration and maximum zone of inhibition was determined against the pathogens. The *P. Thyrsiflorus* Linn., showed significant antibacterial activity against *Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia coli*. The zone of inhibition recorded is 17.67±0.666, 14.0±0.577 against *Staphylococcus aureus*; 16.17±0.477, 14.50±0.428 against *Escherichia coli* and 15.83±0.477, 12.00±0.365 against *Pseudomonas aeruginosa* at the concentration of 1mg/disc, 0.5mg/disc respectively[28]. The zone of inhibition of Ciprofloxacin recorded is 21.83±0.807 against *Staphylococcus aureus, 22.17*±0.472 against *Escherichia coli*, and 20.17±0.60 against *Pseudomonas aeruginosa.*

Anti diarrhoeal activity

Hydroalcoholic extracts of leaves of *Phlogacanthus thyrsiflorus* were investigated by castor oil induced-diarrhoea model & small intestine transit model in experimental rats. The leaves extracts of *Phlogacanthus thyrsiflorus* (100 & 200 mg/kg) treat the diarrhoea and produced significant reductions in fecal output and frequency of droppings. Standard drug Loperamide (3 mg/kg, p.o) was shown significant reductions in fecal output and frequency of droppings whereas Hydroalcoholic extracts at the doses of 100 and 200 mg/kg p.o significantly ($P<0.05$) reduced the castor-oil induced frequency and consistency of diarrhoea. It has been seen that there is marked reduction in the number of diarrhoea stools as well as a modest reduction in intestinal transit. The results obtained establish the efficacy and substantiate the folklore claim as an anti-diarrheal agent[29].

Anti-asthmatic activity

Hydro- alcoholic Extract of *Phlogacanthus thyrsiflorus* has significant bronchodilator activity against histamine. The Hydro-alcoholic extracts of leaf were investigated for Anti-Asthmatic activity by using Isolated Guinea pig ileum preparation & Histamine induced bronchoconstriction model in experimental rats. The extracts of leaves (100 & 200 mg/kg) treat the Asthma and produced significant reductions in ($p<0.01$) percent decreased contraction. Standard drug Chlorpheniramine maleate (10µg/ml, p. o) was showed maximum protection against bronchoconstriction in Guinea pigs. Extract (200 mg/kg) significantly inhibited the histamine induced contraction of isolated Guineapig ileum preparation indicating its H1 receptor antagonistic activity and supports the anti asthmatic properties of the plant. The guinea pigs exposed to histamine aerosol showed signs of progressive dyspnoea leading to convulsions. The Hydro- alcoholic extract significantly prolonged the latent period of convulsions (PCT) as compared to control following the exposure of histamine aerosol. In the study, *Phlogacanthus thyrsiflorus* leaves exhibited antagonistic activity on both histaminergic andserotonergic receptors[30].

CONCLUSION AND FUTURE SCOPE

This review is a meticulous compile of *Phlogacanthus thyrsiflorus* research data on its various therapeutic potentials. This review shows that it is a medicinal plant used in several ethno medicinal treatments mainly for fever, skin diseases, jaundice, liver problems, pneumonia coughs and cold, chronic bronchitis, asthma and rheumatism. The plant contains flavonoids, tannins, phytosterols, phenol, glycosides, fatty acids, galacto-glycero lipid and volatile oil. The pharmacological studies performed on the plant revealed therapeutic potential in the treatment of inflammation, diabetes, jaundice, diarrhea, asthma, infectious diseases (e.g., due to, *Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia coli*) and prevention of oxidative stress. The scientific research on suggest a huge biological potential of this plant. It is strongly believed that detailed information as presented in this review on the phytochemical and various biological properties of the extracts might provide detailed evidence for the use of this plant in different medicines. Analysis of literature

reveals major lacunae and subsequently opens new avenues for research such as isolation of pure compounds and therapeutic validation of these pure compounds to validate traditional claim and also translation of these findings into a possible therapeutic alternative for human consumption that is potent with minimal side effects.

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