



Impatiens balsamina: An overview

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ABSTRACT

Impatiens balsamina belongs to the family *balsaminaceae*, is an annual plant commonly known as 'garden balsam' or 'rose balsam'. This plant is native to southern Asia in India. *I. balsamina* is used in traditional methods such as Ayurveda, Unani and Siddha for various diseases and physiological conditions such as Jaundice, Corns, Snake bite etc. Phytochemical studies revealed the presence of many valuable compounds like naphthoquinones, coumarins, phenolic acids, flavonoids, anthocyanidins and steroids. The different parts of the plants like leaves, stem juice, flower are used in different places. *I. balsamina* have been reported to have various pharmacological activities such as antibacterial, antimicrobial, antifungal, analgesic, anti-inflammatory, antioxidant, antipruritic effects. The current review summarizes published information about the ethanopharmacology, chemical constituents, biological activities and toxicological study *I.balsamina*. The present review summarizes all the research work carried out on this plant in order to provide updated information for future works.

Keywords: Phytochemical studies, Pharmacological activities, *Impatiens balsamina*, Ethanopharmacology, Chemical constituents.

INTRODUCTION

Traditional medicine (also known as indigenous or folk medicine) comprises medical knowledge systems that developed over generations within various societies before the era of modern medicine. The World Health Organization (WHO) defines traditional medicine as:"the health practices, approaches, knowledge and beliefs incorporating plant, animal and mineral-based medicines, spiritual therapies, manual techniques and exercises, applied singularly or in combination to treat, diagnose and prevent illnesses or maintain well-being." [19] India has a rich flora that is widely distributed throughout the country. Herbal medicines have been the basis of treatment and cure for various diseases and physiological conditions in traditional methods practiced such as Ayurveda, Unani and Siddha. Plant derived drugs have been a part of the evolution of human, healthcare for thousands of years. Plant based drugs were commonly used in India.[5] *Impatiens balsamina* is a species of *Impatiens* native to southern Asia in India. It belongs to the family of *Balsaminaceae*. The family consist of more than 1,000 species, but only two genera are recognized [27]. It is an annual plant growing to 20–75 cm tall, with a thick, but soft stem. The leaves are spirally-arranged, 2.5–9 cm long and 1–2.5 cm broad, with a deeply toothed margin. The flowers are pink, red, mauve, lilac, or white, and 2.5–5 cm diameter; they are pollinated by bees and other insects, and also by nectar-feeding birds. The ripe seed capsules undergo explosive dehiscence. Synonyms of *Impatiens balsamina* is *Impatiens coccinea*, *Impatiens corneta*, *Balsamina hortensis*. The balsams have a short life cycle, large flowers, and rather precise differentiation of color classes. The species is one of a family of herbaceous plants which is known to produce leucoanthocyanins and flavonols, hence an intensive genetical and biochemical study may reveal the

metabolic interrelations of several classes of similar compounds[4]. *Impatiens balsamina* (English name-Rose balsam, Hindi name – (Gul mehendi). locally known as balsam in Kerala belonging to the family Balsaminaceae. The leaves are simple, alternate, ovate-lanceolate and serrate[2]. Many compounds have been isolated from *I. balsamina* L., including phenolics, flavonols, anthocyanin pigments, and saponins [9]. The genus *Impatiens* is rich in organic acids, anthraquinones and flavonoids. The isolation of three monoglucosides of kaempferol, quercetin and pelargonidin from the stem of *I. balsamina*. Similarly salicylic acid, sinnapic acid, caffeic acid, scopletin, 2-hydroxy, 1,4-naphthoquinone and 2-methoxy 1,4-naphthoquinone had been extracted and purified from the stem of *I. balsamina* also isolated a new biscoumarin, 4, 40-bisofraxidin, from the roots of *I. balsamina*. [31]. Although the cell cultures were capable of producing coumarin derivatives, scopletin and isofraxidin, the antifungal naphthoquinones were not detected. This work was focused on using 2-methoxy-1,4-naphthoquinone high yielding plants as the initiated material for the establishment of the naphthoquinone producing cell cultures[32]. *I. balsamina* could be used to remove naphthalene as the organic contaminant in the contaminated soil[7]. Colchicine treatment increased plant height, stem circumference, leaf length and number of branches[30].

Different parts of the plant are used as traditional remedies for disease and skin afflictions. Juice from the leaves is used to treat warts and snakebite, and the flower is applied to burns. The extracts of *I. balsamina* also showed a long lasting skin moisturizing effect and prevent dryness, rough skin chap, dandruff and splitting hair ends, hence are used to prepare lotions, creams, hair tonics, cosmetics, bath preparations and detergents[31]. Different parts of the plant are used to treat disease and skin afflictions; the leaves, seeds and stems are also edible if cooked. *Impatiens balsamina* L. has been used as indigenous medicine in Asia for the treatment of rheumatism, fractures and fingernail inflammation[2]. Modern chemical and pharmacological studies have identified flavonol and naphthoquinone derivatives, some of which have strong antimicrobial, anti-anaphylaxis, anti-inflammatory as well as itch alleviating and anti-dermatitis activities, as the main chemical components of this plant[3]. The seeds of this plant are edible. Alcoholic extract of the flowers has been found to have adequate antibiotic activity for against sclerotizing, fructicola and other pathogenic fungi and bacteria. It is reported to be useful for pains in the joints. The seeds of *Impatiens balsamina* Linn were extracted with respective solvents. The successive seed extracts of the plant were tested for their antimicrobial activity. The seed extract in various solvents have been found to possess promising antibacterial[1] and antifungal activities [6]. The plant has been reported to have various pharmacological activities such as antibacterial[23][24], antimicrobial[6].[9]. [16].[33].[34].[36], antifungal[16], analgesic[2]. Antioxidant [9].[18].[31].[36], anticancer[1], antitumor[1].[3], anti-inflammatory[2][35], antipruritic[22], antidermatitic[22], acute toxicity[12].[13], mosquito larvicidal activity[8]. This review intent to summarize diverse studies on this plant and critically evaluates the issues associated to ethanomedicinal uses, phytochemistry, pharmacology and toxicology of *Impatiens balsamina*.

Ethanomedicinal uses of *Impatiens balsamina*.

Region	Ethanomedical uses
Assam(Tinsuka district)	Jaundice(Extract of grounded leaves) Corns(Stem juice) Urinary trouble(Stem and leaf paste)) [14]
Hawaii Island	Emetic Cathartic Diuretic[1] Anticancer Cooling, tonic and antiseptic[11]
Malaysia	Snake bite(leaf) Burn(flower)[19]
West Bengal	
Korea	Scrubulosis Carbuncle Dysentry[2]
China	Anticancer[3] Antimicrobial Antipruritic Antirheumatic Antiallergic Antiinflammatory[9]

Taiwan	Rheumatism Swelling Fingernail inflammation
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Phytoconstituents

Various flower colors exhibited in this species have been ascribed previously to the presence of glycosides of three anthocyanidins: pelargonidin, peonidin and malvidin, but no association of the pigment content with the genetic structure of the plant was made in these studies. The species is one of a family of herbaceous plants which is known to produce leucoanthocyanins and flavonols hence an intensive genetical and biochemical study may reveal the metabolic interrelations of several classes of similar compounds[4].

Induction of naphthoquinone formation in *Impatiens balsamina* cell cultures was achieved by using parent plants with high yielding of 2-methoxy-1,4-naphthoquinone as initiated explants. The cell culture with red-yellowish color was established in B5 medium supplemented with 0.1 mg/l 2,4-dichlorophenoxyacetic acid (2,4-D) and 1.0 mg/l 6-benzylaminopurine (BA). The cell cultures were capable of producing two naphthoquinones, lawsone, and an unknown, which was more polar than lawsone. The time-course of growth and lawsone production in *I. balsamina* cell culture were also established. *Impatiens balsamina* L., Balsaminaceae) has long been used in Thai traditional medicine. Several groups of secondary compounds including naphthoquinone, coumarin derivative, flavonoid and steroid have been reported from this species. Naphthoquinones, lawsone and 2-methoxy-1,4-naphthoquinone, were found to be a group of the main constituents exhibiting antifungal and antibacterial activities. The establishment of *I. balsamina* cell cultures in order to study secondary metabolite production has, been reported previously. Although the cell cultures were capable of producing coumarin derivatives, scopoletin and isofraxidin, the antifungal naphthoquinones were not be detected. This work was focused on using 2-methoxy-1,4-naphthoquinone high yielding plants as the initiated material for the establishment of the naphthoquinone producing cell cultures[20].

Ethylacetate extracts showed higher free radical scavenging capacity and phytochemical analysis revealed the presence of alkaloids, tannins, steroids, saponins and flavonoids[36]. The groups of compounds commonly found in this plant are naphthoquinones, coumarins, phenolic acids, flavonoids, anthocyanidins and steroids. The naphthoquinones, lawsone, lawsone methyl ether and methylene-3,3'-bilawsone are a group of pharmacological active compounds [10].

The compound identified as (3,5,7 trihydroxy-2-(3,4 dihydroxyphenyl-4H chromen-4-one) Quercetin (C15 H10O7)(11). Compounds of 2-methoxy-1,4-naphthoquinone (MeONQ) and stigmasta-7,22-diene-3 β -ol (spinasterol) were isolated from the pods and roots/stems/leaves of *I. balsamina* L., respectively. The active compounds isolated from this plant include peptides (Ib-AMP1-4) from seeds, quinones[1, 4-naphthoquinone, lawsone, 2-methoxy-1,4-naphthoquinone (MeONQ), balsaquinone, impatienol, naphthalene-1,4-dione] from petals, pericarp and aerial parts, and flavonoids (kaempferol, quercetin, rutin, astragalol, nicotiflorin, naringenin and their derivatives) from petals and leaves [15].

The naphthoquinones lawsone, or hennotannic acid, and lawsone methyl ether and methylene-3,3'-bilawsone are some of the active compounds in *I. balsamina* leaves. It also contains kaempferol and several derivatives. Baccharane glycosides have been found in Chinese herbal remedies made from the seeds[34]. A novel natural bisnaphthoquinone, methylene-3,3'-bilawsone, was isolated from root cultures of *Impatiens balsamina*, along with two naphthoquinones (lawsone and 2-methoxy-1,4-naphthoquinone), two coumarin derivatives (scopoletin and isofraxidin) and a sterol (spinasterol)[29].

Pharmacological activities

Antibacterial activity

The antibacterial activities of Hexane, Petroleum ether, Acetone, Methanol, and Aqueous solution extracts from the plant "*Impatiens balsamina*" was screened against selective bacterial human pathogens namely *Shigella boydii*, *Salmonella paratyphi*, *Proteus vulgaris*, *Staphylococcus aureus*, *Candida albicans* and *Cryptococcus neoformans* by disc diffusion method. The bacterial pathogens *Shigella boydii*, *Candida albicans*, and *Cryptococcus neoformans* showed good positive results (Susceptibility) to the plant extract of "*Impatiens balsamina*" that the zone of inhibition of bacterial pathogens were high in the scale of millimeter ranging from 16 mm to 38 mm. The pathogens *Proteus vulgaris* and *Staphylococcus aureus* shows moderate positive results (Susceptibility) to the plant extract of "*Impatiens balsamina*" that the zone of inhibition of bacterial pathogens ranging from 1mm to 29 mm.[23].

Antimicrobial activity

The seeds of this plant are edible. The seed extract of the plant was examined for antimicrobial activity and it has been found to possess remarkable antibacterial and antifungal activities[6]. The in vitro antimicrobial activity of *Impatiens balsamina* leaf and root extracts were studied against selected microbial pathogens. Ethanol extracts showed MIC of 1.0-4.0 mg/ml for bacterial, and 2.0-4.0 mg/ml for fungal isolates. The chloroform extract also showed a moderate antimicrobial activity against the bacterial and fungal pathogens[33]. In terms of antimicrobial activity, leaf extracts showed higher inhibitory effects against microorganisms than those of stem extracts. For centuries, preparations from the aerial parts of *I. balsamina* L. have been used in traditional Chinese medicine for antimicrobial purposes[9]. Lawsonone (1), lawsonone methyl ether (2), and methylene-3,3'-bilawsonone (3) are the main naphthoquinones in the leaf extracts of *Impatiens balsamina* L. (Balsaminaceae). Antimicrobial activities of these three naphthoquinones against dermatophyte fungi, yeast, aerobic bacteria and facultative anaerobic and anaerobic bacteria were evaluated by determination of minimal inhibitory concentrations (MICs) and minimal bactericidal or fungicidal concentrations (MBCs or MFCs) using a modified agar dilution method. Compound 2 showed the highest antimicrobial activity[21].

Antifungal activity

Ib-AMP4 is an antimicrobial peptide of *Impatiens balsamina* (Balsaminaceae). Ib-AMP4 was produced as a recombinant peptide and in this study its antimicrobial activity against human bacterial pathogens was investigated. Ib-AMP4 was bactericidal against both Gram positive and Gram negative bacteria with MIC values between 0.49 and 3.5 M in sensitive species. A genuine synergistic effect was achieved when IB-AMP4 was employed in combination with the plant monoterpene thymol against drug resistant *Klebsiella pneumoniae*(KPC) ATCC700603, or with the antibiotics vancomycin or oxacillin against *Enterococcus faecalis* (VRE) ATCC51299[16].

Analgesic activity

Analgesic effects were studied in suitable animal models using aqueous extract of *Impatiens balsamina* leaves. The extract obtained from *Impatiens balsamina* was screened for analgesic activity using tail flick method. The findings of the present study show that the aqueous extract of the leaves of *Impatiens balsamina* L. has significant analgesic without any adverse effects[2].

Antioxidant activity

The present study reports the antioxidant activity of the whole plant of *Impatiens balsamina*, (Balsaminaceae), on chromium induced oxidative stress in male albino rats. Oxidative stress was induced in albino rats by force-feeding of potassium dichromate equivalent to a dose of 30 mg/kg body weight of chromium(IV) for 30 days. Administration of chromium decreased the bodyweight ratio significantly. Chromium treatment significantly decreased reduced glutathione (gsh), and increased malondialdehyde (MDA) levels; further it also reduced catalase (cat) aspartate amino transferase (ast), and alanine amino transferase (ALT) did not affect SOD levels in the serum. The plant ethanolic extract were evaluated for the protection against the chromium induced oxidative stress. The result shows that the extracts at a concentration of 200mg/kg BW protect chromium induced oxidative stress[31].

Anticancer activity

Study conducted using the ethanol extract of *Impatiens balsamina* showed anticancer activity and in-vitro cytotoxicity against transplantable tumors and human cell lines. In vitro cytotoxicity was evaluated in Hela and NIH3T3 cells by MTT assay and in-vivo antitumor activity with Dalton's ascites lymphoma (DLA) bearing mice. Activity was measured by monitoring Cancer cell number, packed cell volume and increase in life span. The extract exhibited strong in vitro cytotoxicity against Hela cell line, it was found to be safe with the normal cell[1].

Antitumor activity

The ethanol or chloroform extracts of the leaves of *Impatiens balsamina* (LIB) have anti-tumor activity against the human hepatocellular carcinoma cell line HepG2[3]. Another study conducted using the ethanol extract of *Impatiens balsamina* showed antitumor activity against transplantable tumors and human cell lines. In vitro cytotoxicity was evaluated in Hela and NIH3T3 cells by MTT assay and in-vivo antitumor activity with Dalton's ascites lymphoma (DLA) bearing mice[1]. *Impatiens balsamina* Linn. is an ornamental plant with a wide range of bioactivities. This histological assessment was done as a continuation of a study that showed the anti-tumor promoting activity of its flower crude ethanol extract and isolate 2-methoxy-1,4-naphthoquinone (MeONQ) using the modified 2-stage mouse skin carcinogenicity assay results show that *I. balsamina* crude leaf extract and isolate MeONQ exhibit

histoprotective effects on the pancreas, stomach, duodenum, and spleen of tumor-induced mice indicative of anti-tumor activity[25].

Antiinflammatory activity

Antiinflammatory effects were studied in suitable animal models using aqueous extract of *Impatiens balsamina* leaves. The extract obtained from *Impatiens balsamina* was screened for anti-inflammatory activity using carrageenan induced paw oedema method in albino rats[2].

Antipruritic activity

Dinaphthofuran-7,12-dione derivatives named balsaminones A (1) and B (2) were isolated from the pericarp of *Impatiens balsamina* L. together with the known compound 2-methoxy-1,4-naphthoquinone (3). Their structures were elucidated by spectral techniques. These compounds have significant antipruritic activity[26].

Antiallergic activity

It has been subsequently shown that administration of extract from petals of *Impatiens balsamina*L. including flavonoids such as kaempferol 3-rutinoside and 2-hydroxy-1,4-naphthoquinone as active gradients suppressed scratching behaviour and dermatitis[17].

Antianaphylactic activity

The antianaphylactic activity of 35% EtOH extract (IB) from the white petals of *Impatiens balsamina* L. was investigated using murine immediate hypersensitivity reaction system induced by hen egg-white lysozyme (HEL). IB has a significant antianaphylactic activity[28].

Toxicology Studies of *Impatiens balsamina*

Garden balsam (*Impatiens balsamina* Linn) is a plant that has been used for joint pain, insect bite, promotes regular menstrual cycle and prevents stomach cancer. Traditionally, the leaves of garden balsam are suspected to contain poison that can affect the digestive system. Stem and leaf Methanol extract of garden balsam was fractioned into n-hexane fraction with liquid extraction method. Phytochemical screening showed that the fraction contains triterpenoid steroid compound. Limit test showed that the n-hexane fraction LD50 is greater than 5000 mg/kgBW. There were no clinical sign of toxicity on the eye, respiration system, behaviour, autonomic and somatomotoric system up to dose 5000 mg/kgBW. At that dose, the fraction did not cause mortality on rats, and did not lower the body weight, food and water consumption of rats. The fraction also did not cause any histology change to the liver and renal. Our conclusion is the fraction is safe to consume below 5000mg/kgBW. According to Loomis classification, n-hexane fraction of garden balsam stem and leaf has low toxicity[13].

CONCLUSION

The objective of this review is to show the recent advances in the exploration of the plant *Impatiens balsamina*. The information as presented in this review on the pharmacognostical and various biological properties of the plant will provide detailed evidence for the use of this plant in various ailments. The plant is reported to contain mainly naphthoquinones, coumarins, phenolic acids, flavonoids, anthocyanidins and steroids which might be useful in the development of new drugs of versatile nature to treat various diseases because of their different pharmacological activities. Till now, no study is available leading to pure active components for particular disease hence; there is scope for research work leading to commercial utilization of the *Impatiens balsamina* in near future.

Acknowledgement

Our sincere thanks to Mrs. Alexeyena Varghese for encouraging and supporting us throughout the work. We also thank Almighty for the blessings.

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