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Review Article

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Potential of *Impatiens walleriana* Hook.f. as medicinal herb and otherwise - An update

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ABSTRACT

The healing potential and usefulness of plants is known since historic times. *Impatiens walleriana* Hook.f. (Family - Balsaminaceae) is the most cultivated plant from the genus "Impatiens". It is explored by floriculture and horticulture industries. It has culinary uses with the potential to be researched by the food industry. Many modern medicines are plant-derived and *I. walleriana* has the potential to be used as medicine as backed by ethnopharmacological data. *I. walleriana* finds a number of traditional/folk medicinal claims. All parts of the plant and in varied formulations are used traditionally to treat various ailments. The data reviewed shows its safety in uses and its nontoxic nature. Among the Impatiens species *I. walleriana* is the less researched one. Few studies pertaining to its antioxidant, antimicrobial and antitumor activities are reported. Phytochemical constituents have been identified and reported by some researchers. Following a detailed study of published information and reported activities current review on the one hand summarizes the research work that has been carried out on the other hand gives food for thought for researchers to undertake more work in the direction of finding its usefulness using scientific methodologies and establishing the ethnic claims.

KEYWORDS: *Impatiens walleriana*, Ethnomedicine, Phenolics, Antitumor, Antioxidant

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INTRODUCTION

Since historic times, plants have played an important role in health care. Traditional systems of medicine did gain popularity owing to the belief that they are safe, effective, time-tested and have few side effects (Choudhury *et al.*, 2020). Many drugs in current therapy are the ones developed or obtained from plant products (Gross *et al.*, 2019). Plants are recognized as a valuable source of new and complementary medicinal products (Anokwuru *et al.*, 2011). Ethnobotany/Ethnopharmacology are basic approaches for the selection of medicinal plants. Knowledge about plant use, and their pharmacological and toxicological properties is fundamental to assure their safety and effectiveness (Gross *et al.*, 2019).

Balsaminaceae contains more than 1200 species spread across tropic and subtropic regions (Haider & Ullah, 2019). Two genera are recognized Hydrocera and Impatiens (Meenu *et al.*, 2015; Utami & Shimizu, 2005). Genus Impatiens is extensively found in the mountains of Southeast Asia, south China, India and Africa. In traditional medicine plants belonging to the Impatiens genus have been used to treat articular rheumatism, bruises, beriberi, etc (Singh *et al.*, 2017). Several studied species have revealed that more than 300 different compounds are present like flavonoids, phenolic acids, terpenes, saponins, coumarins, quinines, etc. Carbohydrates, lipids and proteins are the main macronutrients present (Pires *et al.*, 2021a). Genus Impatiens is recognized for antioxidant and antimicrobial activity (Singh *et al.*, 2017). Apart from antioxidant and antimicrobial activity, the genus is also known for antiallergic, antipruritic, antidermatitic, antihistaminic, and COX-2 inhibitory activities (Pires *et al.*, 2021a). The genus is valued for emetic, cathartic, diuretic and antihaemorrhoidal potential (Kirtikar & Basu, 1980). Several species are ornamental edible and are part of alternative medicine. In particular *I. walleriana* has relevance in the pharmaceutical field (Pires *et al.*, 2021a). *I. walleriana* is one of the most cultivated plants from the Impatiens genus (Delgado-Rodriguez *et al.*, 2018).

I. walleriana is a common ornamental or bedding plant that thrives in richly moist soil. It is called "Busy Lizzie" as it flowers persistently and is called "Touch-me-not" because its ripe seeds readily explode even with the least touch i.e. it is impatient in holding its seeds. It is considered an environmental weed in parts of Australia (Perry, 2016; Plants Rescue, n.d.). *I. walleriana* or simply "Impatiens" is native to Malaysia, Indonesia, India, China and East Africa where it grows extensively in Kenya, Tanzania and Mozambique (Christenhusz, 2010; Haider & Ullah, 2019). In the tropics and subtropics, the species is naturalized along roads competing with other species. It was

first discovered during expeditions up the Zambezi River by Dr David Livingstone with Dr John Kirk Ref. Horace Waller between 1858-1864. The former species' name of this was "Sultani" sometimes called Sultana after the Sultan Bargash of Zanzibar with whom Dr Kirk was diplomatically involved (Christenhusz, 2010).

I. walleriana grows to a height of 12-15 inches, has broad mostly alternate leaves. Flowers have five petals and spur. Hybrid strains exhibit flowers bearing white, pink, red, orange shades sometimes bicoloured also with more than one layer of petals. Foliage is elliptic or heart shaped and coloured (Plants Rescue, n.d.). Flowers are borne profusely, they have 2-5 cm diameter and stems are semi-succulent (Mukul, 2017). *I. walleriana* belonging to Africa has alternate leaves, many flowered umbels and flowers with long spur (Utami & Shimizu, 2005). *I. walleriana* is the scientific name of the plant. It has synonyms, common/English names and lot many vernacular names as summarized in Table 1.

Ethnomedicinal/Folk Uses

As per data obtained from a literature survey of plants used in South Africa *I. walleriana* is reported as a traditional medicine (Williams *et al.*, 2021). This shrub is reported as a medicinal plant in Brazil with no toxicological potential (Conde *et al.*, 2014a). A juice made out of dried pounded leaves and roots mixed with water is used as an abortifacient (Lim, 2014). In Bale, Ethiopia potato-like roots of *I. walleriana* are used to strengthen hair in women (Bussmann *et al.*, 2011). As per ethno botanical surveys in southern Brazil *I. walleriana* in tea form is used as an antidepressant, tranquilizer or sedative (Gross *et al.*, 2019). Leaves in the steam bath are used in chicken pox, and fever by Batak Toba tribes in north Sumatra, Indonesia (Silalahi *et al.*, 2019). *I. walleriana* is sold as a medicinal plant for cancer and fever as recorded in Kabanjahe traditional market, North Sumatra, Indonesia (Silalahi *et al.*, 2015). In Heredia City, Costa Rica flowers are rubbed on hands to heal wounds (Gonzalez-Ball *et al.*, 2022). Ethnopharmacology in the vicinity of the Federal University of Juiz de Fora, Brazil reveals the use of *I. walleriana* in the treatment of uterine infections (Conde *et al.*, 2014a, 2014b). Chinese use *Impatiens walleriana* for amenorrhoea, dysphagia and its seeds as antifungal (Lopes *et al.*, 2009). A preparation made by cooking root, called 'Salep' is used in the treatment of gastrointestinal irritations for its soothing, demulcent effects. It is also used to prepare a jelly that forms the essence of remedy for mental stresses and tensions, calming feelings of impatience or irritability (Mukul, 2017).

Stem and roots are fed to pigs (Hemp, 1999; Bussmann *et al.*, 2011). Flowers are nutritious, edible, and have flavor, in particular, pink ones have a sweet taste and are nontoxic (Rop *et al.*, 2012). In Kenya, sweet petals of *I. walleriana* are used in salads additionally mixed in fancy drinks (Tuladhar, 2021). *I. walleriana* is also listed in Hawaiian ethnopharmacopoeia (Palmer, 2004).

Other Uses

I. walleriana is an ornamental plant and an entity for floriculture, and horticulture. It has numerous small flowers. Its attractively coloured flowers have aroused great interest in the food industry. Flowers being rich in anthocyanins are considered real "Pharmaceutical ingredients". *I. walleriana* continues to be studied as food (Benvenuti & Mazzoncini, 2021). It is edible (Haider & Ullah, 2019). Flowers are a source of antioxidants and their mineral composition can be a good source of essential elements (Tuladhar, 2021). Cooked root 'Salep' is nutritious. It is boiled in water flavored and prepared as arrowroot for use in children's diets also in diets for convalescents (Mukul, 2017). As the stem and root of *I. walleriana* are fed to pigs there is scope for its use in animal husbandry (Hemp, 1999; Bussmann *et al.*, 2011). Its fungicidal property has a propensity to be used in the agriculture sector (Domnigues *et al.*, 2009). *I. walleriana* attracts mosquitoes and can be employed in developing mosquitocidal nectar plants (Kearney & Chen, 2014). *I. walleriana* can be used as an additive to traps for reducing mosquitoes (Barredo & DeGennaro, 2020). *I. walleriana* concentrates toxic metals from soil. This aspect should be borne in mind when it is cultivated for medicinal purposes (Naeem *et al.*, 2009). It has been employed for removing metal contamination from soil (Schenato *et al.*, 2008).

Table 1: Synonyms, Common/English and Vernacular names

Synonyms (Lim, 2014; Plants Rescue, n.d.)	*Impatiens episcopi* H.J. Veitch, *Impatiens giorgii* De Wild., *Impatiens holstii* Engl. & Warb., *Impatiens lujai* De Wild., *Impatiens sultanii* Hook.f., *Impatiens petersiana, Impatiens wallerana.*
Common/English names (Kingsman, 1985; Lim, 2014)	Balsam, Bizzy – Lizzie, Busy Lizzy, Garden Impatiens, Impatiens, Japanese Balsam, Jewel Weed, Patience plant, Patient Lucy, Shady Lady, Snapweed, Sultan's Balsam, Sultan's Flower, Sultana, Zanzibar Balsam, Hill balsam.
Vernacular names (Fernandes *et al.,* 2010; Conde *et al.,* 2014a, 2014b; Lim, 2014; Silalahi *et al.,* 2015; Gross *et al.,* 2019; Gonzalez-Ball *et al.,* 2022)	Brazil: Beijo De Frade, Beijo branco, Maria-Sem-Vergonha, Beijinho and Maravilha Chinese: Su Dan Feng Xian Hua. Dutch: Juliaantje. East Africa: Sunguala (Chagga) and Matuanange (Zanzibar). India: Khujuang Lei (Manipuri). French: Balsamine Sauvage. German: Fleissiges Lieschen. Samoan: Patiale. Spanish: Balsamina, Chino. Swedish: Flitiga Lisa. Tongan: Polosomo. Sumatra, Indonesia: Bunga pancur. Vietnamese: Mong Tay Suitan

Chemical Constituents and Activities Reported by Researchers

More than 300 distinct compounds exist in the broad genus Impatiens with mainly flavonoids, phenolic acids, coumarins, quinines, terpenes, steroids and saponins (Singh, 2017; Pires *et al.*, 2021b). Essential oils are also reported to be present within Impatiens (Szewezyk & Marta, 2017). Anthocyanin flavonoids Cyanidin ($C_{15}H_{11}O_6$+) and Malvidin ($C_{17}H_{15}O_7$+) are reported to be present in *I. walleriana*. Thirteen phenolic acids gallic acid, protocatechuic acid, gentisic acid, 4-hydroxybenzoic acid, vanillic acid, trans-caffeic acid, syringic acid, trans-p-coumaric acid, cis-p-coumaric acid, trans-ferulic acid, salicylic acid, cis-ferulic acid, 3-hydroxycinnamic acid are also reported to be present in *I. walleriana* (Pires *et al.*, 2021b). The phenolic acid profile has been determined using LC-MS (Szewezyk & Marta, 2017). *I. walleriana* whole plant extracts showed antioxidant and antimicrobial activities. Phytochemical screening revealed the presence of phenols, tannins, flavonoids, terpenes, carbohydrates, reducing sugar, amino acids and soluble proteins (Delgado-Rodriguez *et al.*, 2018). In yet another study extract of leaves showed antioxidant and antimicrobial activity wherein researchers reported total phenolic content in the extract (Haider & Ullah, 2019). Leaf extract of *I. walleriana* when screened for cytotoxic and antiviral activity against animal herpesviruses showed a cytotoxic effect but no antiviral activity (Fernandes *et al.*, 2010). *I. walleriana* edible flowers have 4.60 g/kg crude protein and phosphorus 382.73 mg/kg fresh mass, potassium 2835.25 mg/kg fresh mass, calcium 405.62 mg/kg fresh mass, magnesium 203.34 mg/kg fresh mass, sodium 94.29 mg/kg fresh mass, iron 7.26 mg/kg fresh mass, manganese 6.05 mg/kg fresh mass, copper 1.31 mg/kg fresh mass, zinc 8.72 mg/kg fresh mass, molybdenum 0.39 mg/kg fresh mass (Lim, 2014). *I. walleriana* flowers showed total phenolic content of 4.85 g of gallic acid/kg of fresh mass, a total antioxidant capacity of 6.89 g/kg of fresh mass and total flavonoid content of 1.93 g/kg of fresh mass (Rop *et al.*, 2012; Lim, 2014). Chemical and bioactive characterization of pink and orange flowers of *I. walleriana* is reported. The orange variant has a greater variety of phenolic compounds compared to the pink but the pink variant has more content of phenolic compounds. Ten anthocyanin phenolic compounds have been identified-four pelargonidin glycosylated derivatives, three malvidin derivatives and three peonidine derivatives with orange flowers showing the highest pelargonidin concentration and pink showing the highest malvidin concentration. Pink petals showed better antioxidant activity compared to orange petals. The effect of petals on tumor cell lines is reported with both petals showing positive results for breast adenocarcinoma, cervical carcinoma and hepatocellular carcinoma. Orange petals in addition inhibited non-small cell lung cancer cell lines. Overall orange petals showed better antitumor performance compared to pink flowers. Both flower extracts exhibited satisfactory anti-inflammatory, antibacterial and antifungal activities (Pires *et al.*, 2021b). Cytotoxicity of *I. walleriana* extracts on human gastric adenocarcinoma and ovarian carcinoma cell lines is reported with the extract showing the most cytotoxic effect on human gastric adenocarcinoma cell lines. The amount of anthocyanin and carotenoid derivatives was additionally investigated (Hanachi *et al.*, 2021) Employing different solvent extracts of *I. walleriana* and *Ocimum basilicum* antioxidant, antibacterial and antitumor properties have been reported by comparison (Hanachi *et al.*, 2020) Triacylglycerol and fatty acid compositions of *I. walleriana* seed oil by reverse phase HPLC revealed presence of conjugated octadecatetraenoic moieties. *I. walleriana* seed oil contains 27.07% α-parinaric, 9.65% β-parinaric, 28.20% linolenic, 14% linoleic, 15.87% oleic and 5.18% saturated fatty acid (Nguyen *et al.*, 2022).

Taxonomy is confusing as far as *Impatiens* genera are concerned. With the help of scanning electron microscopy, the seed coat of *I. walleriana* has been extensively studied in order to generate data that can further help in its taxonomy (Utami & Shimizu, 2005). In one of our previous findings, the results of which were published and we evaluated *I. walleriana* whole plant extracts antioxidant effect and effect against uterine infection causing organisms with positive promising results (Kulkarni & Sutar, 2021; Kulkarni *et al.*, 2022).

CONCLUSION

The review highlights the developments that have surfaced in the study of *I. walleriana*. Data pertaining to the plant's varied names, uses, particularly ethnomedicinal uses, and phytochemical constituents are collated and presented. The review throws light on the areas where research is lacking by summarizing the research activities reported so far. *I. walleriana* has a number of attributes from being ornamental, decorative to being a medicine, nutritious food or even weed. It flowers throughout the year and grows extensively. Its immense potential can be trapped and put to good use as a natural antioxidant or as a colorant in the food/cosmetic/pharma industry. It can be employed for protecting foodstuffs against fungi. This plant with its rich content of polysaccharides and phenolics can serve as a renewable source for these constituents. It is not sufficiently investigated for its constituents and biological activities. Besides species, the genus Impatiens holds the key to new findings as well. *I. walleriana* is a remedy for various ailments as per ethnic claims and can be scientifically evaluated for the same. Among others there is scope for furthering antitumor studies.

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