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Review Article

A comprehensive review on the genus: *Mussaenda*

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ABSTRACT

Medicinal plants serve as an integral part in fulfilling the human needs by serving with number of resources. The rubiaceae family is a rich source of medicinal plants with 500 genus and 5300 species within it. One of the active members among the genus is *Mussaenda*. *Mussaenda* is a genus of flowering plants with numerous ornamental plants. It includes near about 194 species. This present review paper comprises of the importance of the genus *Mussaenda* including its phyto and pharmacological aspects.

Keywords: Medicinal plants, Rubiaceae, *Mussaenda*, phytochemistry and pharmacology.

INTRODUCTION

Traditional medicine is an important source of potentially useful new compounds for the development of chemotherapeutic agents (Surendra Kumar et al., 2011). Medicinal plants serves as an important source of treatment for various ailments. Various medicinal plants are identified and studied using scientific and modern approaches (Surendra Kumar and Ravichandran, 2011). The rubiaceae family is a rich source of medicinal plants with 500 genus and 5300 species in it. Majority of the family members are trees or shrubs and the plant shows great variations in its habitat. *Mussaenda* is an active member of the family rubiaceae. This genus includes numerous ornamental plants with 194 species. The genus *Mussaenda* is a wealthy source of medicinally important phytoconstituents such as terpenes, flavanoids and iridoids. The numerous species of this genus is easy growing and said to possess numerous medicinal properties such as antibacterial, anti-inflammatory, antioxidant, antipyretic, antiviral, cytotoxicity, diuretic, etc., (Shylaja Gunasekaran et al., 2015). The present review focuses on some of the important species of *Mussaenda* for their phytoconstituents and pharmacological properties.

Taxonomical classification

Kingdom: Plantae

Subkingdom: Tracheobionta

Superdivision: Spermatophyta

Division Magnoliophyta

Class Magnoliopsida

Subclass Asteridae

Order: Rubiales

Family: Rubiaceae

Genus: *Mussaenda* L.

Phytochemistry and pharmacological review on *Mussaenda* genus

Mussaenda arcuata Poir.

Phytoconstituents isolated from leaves are Rutin, astragalin, isoquercitrin, kaempferol-3-O-β-D-rutinoside, melilotoside, dihydro melilotoside (Ranarivelo et al., 1990; Lakshmi et al., 1985).

Leaves are used for the treatment of fever and inflammation (Fortina et al., 2002); The Whole plants was used for the treatment of depurant, febrifuge, purgative, asthma, albuminuria, gastroenteritis conjonctivitis and dermatosis (Poullain et al, 2004); Roots are used for the pre hepatic jaundice, skin rashes in babies (Paul Ssegawa and John Massan Kasenene, 2007); Leaves and stem are said to possess antioxidant and free radical scavenging activity (Poullain et al., 2004).

Mussaenda dona aurora (*Mussaenda Philippica* A. Rich. var. *aurora* Sulit)

Phytoconstituents isolated from the sepals are three iridoid glycosides and four flavanoids (Vidyalakshmi and Rajamanickam, 2009).

Sanshiside – D isolated from *Mussaenda dona aurora*, a iridoid glycoside suppress the growth of vero cell lines (Vidyalakshmi and Rajamanickam, 2009), it also exhibits significant level of cytotoxicity on the growth of vero (African green monkey), HeLa and SMMC-7721 (human heptoma) cell lines (Biswanath Dinda et al., 2011). Extract and isolated compounds from *Mussaen-*

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da dona aurora said to possess antioxidant and hepatoprotective activity (Kandulva Sethuraman Vidyalakshmi et al., 2009).

***Mussaenda erythrophylla* Schumach. & Thonn.**

Phytoconstituents isolated are 5 hydroxy-7, 4'-dimethoxy flavones, β-sitosterol, 4 -hydroxy-3-methoxy cinnamic acid and 3- iso cumaryloxy – cyclopropane-1-oic acid (Chinna Eswaraiah and Elumalai, 2011).

Leaf is used for paracetamol induced hepatotoxicity (Rojin et al., 2015)[a]; alcohol induced hepatotoxicity (Rojin et al., 2015)[b]. Stem is found to be hepatoprotective against carbon tetra chloride induced hepatotoxicity **(**Chinna Eswaraiah and Satyanarayana, 2010)[a] and used for antioxidant and free radical scavenging activity **(**Chinna Eswaraiah and Satyanarayana, 2010)[b]. Roots are found to be anthelmintic (Jaya Raju and Ganga Rao, 2011); diuretic,used for the treatment of cough, jaundice, acts as an appetizer (Venkatesh et al., 2013)**.** Whole Plant is used as an *antiarthritis* (Partha Palit, 2013) and anthelmintic (Jaya Raju and Ganga Rao, 2011).

***Mussaenda erosa* Champ. ex Benth.**

M. erosa stem, leaves and whole plant were used for the treatment of burn, bruise, ulcer, venereal disease and numbness of limbs (Chun-lin Long and Rong Li, 2004).

***Mussaenda esquirolli* Levl.**

Phytoconstituents isolated from the leaves are linolenic acid, phytol, squalene and β-sitosterol acetate (Xiao-Qian Hu et al., 2014).

***Mussaenda flava* (Verdc.) Bakh. F**

Flowers of *Mussaenda flava* shows *i*nhibitory activity against *Bacillus subtilis* (Erlina Abdullah et al., 2011).

***Mussaenda frondosa* L.**

20 phytoconstituents were isolated and identified from the whole plant (Gopalakrishnan S and Vadivel, 2011). Flowers contain quercetin, hypenin, ferulic acid, sinapic acid, β-sitosterol, β-sitosterol glucoside (Lakshmi et al, 1985).

Leaves are used for the treatment of jaundice, asthma, hyperacidity, fever, ulcer, leprosy and used as diuretic (Kumarasamyraja et al., 2012). Leaves are said to possess anthelmintic activity (Asha Kesari and Bhim Charan Maiti, 2015), hepatoprotective activity against ethanol (Sambrekar Sudhir et al., 2012); hepatoprotective against isoniazid induced hepatotoxicity (Sambrekar Sudhir et al., 2014), Wound healing and antibacterial activities (Patil et al., 2010) antimicrobial activity (Jayasinghe et al., 2002).

Whole plant possess diuretic activity (Sreelakshmi et al., 2015), antioxidant activity (Siju et al., 2010). Root is used to treat blemishes on the tongue and the sepals are diuretic (Jayasinghe et al., 2002). Root is used for radical scavenging and antistress activity (Sameksha Koul and Anu Chaudhary, 2011), wound healing activity (Prasanta et al., 2013). Root shows antibacterial activity against *Staphylooccus aureus* (Nugraha and Keller, 2011), *Pseudomones aeruginosa* and *Escherichia coli* (Shylaja Gunasekaran et al., 2015). Extract of bark was found to be antibacterial (Jayasinghe et al., 2002).

***Mussaenda glabrata* (Hook. F.) Hutch. ex Gamble (*Mussaenda frondosa* var. *glabrata* Hook. F.)**

The leaves contain resin, sugar, mucilage, saponin glucoside, coloring matter, rutin, quercetin, hyperin, β-sitosterol, ferulic acid, glucoside and sinapic acid.

Leaves are used for the treatment of hepatitis and jaundice (Zahed Bin Rahim et al., 2012). Roots are used as antioxidant and anti-inflammatory (Darsan et al., 2011).

***Mussaenda glabra* Vahl (*Mussaenda frondosa* var. *glabra* (Vahl) Miq.)**

Flowers possess free radical scavenging activity (Vidyalakshmi et al., 2006).

***Mussaenda hainanensis* Merr.**

The phytoconstituents isolated from the whole plants were quercetin, 8-O-acetyl-shanzhiside methylester, pinostrobin, 8[E]-N-[2'-hydroxyl-tetracosan- cosoyl]-1-D-glucopyranosy1-8-en-octadecasphingenine, quercetin-3-O-β-D-glucosid, caffeic acid, quercetin-7-O-β-D-glucoside, 3,4-di-*o*-caffeoylquinic acid, 3β-O-β-D-glucopyranosyl pomolic acid 28-O-β-D-glucopyranosyl ester, chlorogenic acid, shanzhiside methyl ester and lamalbid (Yu-xian Li et al., 2011).

***Mussaenda hirsutissima* (Hook. F.) Hutch. ex Gamble**

Flowers contain quercetin, Rutin, Hypenin, ferulic acid, sinapic acid, β-sitosterol, β-sitosterol glucoside (Lakshmi et al., 1985), Aureusidin-4-glucoside, Aureusidin-6-glucoside, Aureusidin-4,6-diglucoside, cernuoside (Harborne et al., 1983). Rutins are isolated from the leaves (Ranarivelo et al., 1990).

***Mussaenda hossei* Craib ex. Hosseus**

M. hossei root, leaf and barks were used for the treatment of burns and cough (Abdolbaset Ghorbani et al., 2011).

***Mussaenda incana* Wall.**

Phytoconstituents such as iridolactone, shanzilactone I, iridoidglucosides, mussaenosides, barlerin(8-O- acetyl shanziside methyl ester), lupeol and β-D- glucose were isolated from the stem (Biswanath Dinda et al., 2005). From *M. incana* stem two triterpene 3-benzoylepibetulin and esters-3-palmitoyllupeol along with β-sitosterol were isolated (Dinda et al., 2004).

Here the plant is used as an antioxidant and anti-inflammatory (Swarnalatha et al., 2014)[a].

***Mussaenda laxiflora* Merr.**

The whole plants of *M. laxiflora* was used for the treatment of injuries from falls, , arthritis, numbness of limbs, rheumatoid arthritis, hemiplegia and bellyache (Chun-lin Long and Rong Li, 2004).

***Mussaenda luteola* Delile**

Phytoconstituents such as heinsiagenin A 3-O-[α-L-rhamnopyranosyl-(1→2)-β-D-glucopyranosyl-(1→2)]-β-D-glucopyranoside, heinsiagenin A 3-O-[α-L-rhamnopyranosyl-(1→2)-β-D-glucopyranosyl-(1→2)]-[β-D-glucopyranosyl-(1→4)]-β-D-glucopyranoside, 2α-hydroxyheinsiagenin A 3-O-[α-L-rhamnopyranosyl-(1→2)-β-D-glucopyranosyl-(1→2)]-β-D-glucopyranoside, 2α-hydroxyheinsiagenin A 3-O-[β-D-glucopyranosyl-(1→2)]-[β-D-glucopyranosyl-(1→4)]-β-D-glucopyranoside and N-(2S, 3R, 4R-3-methyl-4-pentanolid-2-yl)-18-hydroxylanosta-8, 22E, 24E-trien-27-amide-3-O-[α-L-rhamnopyranosyl-(1→2)-β-D-glucopyranosyl-(1→2)]-[β-D-glucopyranosyl-(1→4)]-β-D-glucopyranoside (Shaymaa et al., 2015); 9 (R), 19, 22 (S), 24 (R) bicyclolanost-3β, 12α, 16β, 17α tetrol-25-one 3-O-β-D-glucopyranosyl-(1→2)-β-D-glucopyranoside, 10-methoxy pumiloside, 10-methoxy strictosidine, 7α-morroniside, 7-epi-loganin, (7β)-7-O-methylmorroniside, 5(S)-5-carboxystrictisidine and apigenin-7-O-neohesperidoside were isolated from aerial parts of *Mussaenda luteola* (Shaymaa et al., 2016).

***Mussaenda macrophylla* Wall.**

Root bark contains rotundic acid (Zhao et al., 1997), 3-O-Acetyl-6β-hydroxy-olean-12-ene; 3-O-Acetyl-olean-12-en-28-oic acid; 16α-hydroxyprotobassic acid; 28-O-β-D-Glucopyranosyl-16α-hydroxy-23deoxyprotobassic acid**;** 3-O-β- D-Glucopyranosyl-28-O-α-L-rhanmo pyranosyl- 16α-hydroxy-23-deoxyprotobassic acid**;** 3-O-β-D-Glucopyranosyl-28-O-α-L-rhamnopyransoyl-16α-hydroxyprotobassic acid**;** Mussaendoside W (Kim et al., 1999).

Leaves were found to be antioxidant and cytotoxic (Farhana Islam et al., 2012), root bark shows inhibitory activity against *Porphyromonas gingivalis* (Kim et al., 1999)**,** inhibition against *Salmonella paratyphi* and *Aspergillus niger* (Sharmin Reza Chowdhury et al., 2013).

***Mussaenda multinervis* C.Y. Wu ex H.H. Hsue & H. Wu**

The roots of *M. multinervis* was used for the treatment of arthralgia and backache (Abdolbaset Ghorbani et al., 2011).

***Mussaenda parviflora* Miq.**

Mussaenoside and shanzhiside methyl ester was isolated from the plant (Yoshio Takeda et al., 1997).

Triterpenoids from the leaf and root of *M. parviflora* was useful for the treatment of malarial fever (Thomas SC and Li, 2016).

***Mussaenda philippica* A. Rich.**

Phytoconstituents such as 4-acetoxy-7-methoxy secologanin, hydroxy davisiosides and 6-methoxy mussaenoside as well as two flavones, 5,7-dihydroxy-6, 3′,4′-trimethoxy flavones and 5,7,4′-trihydroxy-3′-methoxy flavones were isolated from sepals (Kamurthy et al., 2014).

These Leaves were used as an antibacterial and anti-fungal (Renilda Sophy et al., 2015) and said to possess antioxidant activity (Felmer et al., 2016) and analgesic (Sikder et al., 2013). Leaves and sepals were used as an anticonvulsant (Kar et al., 2014) and for jaundice (Melfei Estrada Bungihan and Claribel Asuncion Matias, 2013).

Flowers were used as an antibacterial, antioxidant (Melfei Estrada Bungihan and Claribel Asuncion Matias, 2013) and sepals were found to be antioxidant and antitumor activity against breast cancer and colon cancer cell lines (Lakshmi et al., 2014). Bark is used as a remedy for dysentery**,** stomach ache, leaves for lung and chest infections (Melfei Estrada Bungihan and Claribel Asuncion Matias, 2013).

Stems of *Mussaenda philippica* was found to be hepatoprotective against antitubercular drug induced hepatotoxicity (Swarnalatha et al., 2014)[b], antioxidant and anti-inflammatory (Swarnalatha et al. 2014)[a].

The leaves, stem, bark of *Mussaenda philippica* was found to be antibacterial (Erlina Abdullah et al., 2011).

***Mussaenda pubescens* Ait. F**

From the aerial parts of *Mussaenda pubescens* phytoconstituents such as Mussaendoside F **(**Weimin Zhao et al., 1995), Mussaein A, Mussaein B, Mussaein C and argyol (Weimin Zhao et al., 1996), Mussaendoside F **(**Weimin Zhao et al., 1995), 3β,23~Dihydr0xy-urs-1 2-en-28-oic acid, 3β,l9α, 24-Trihydroxy-urs-12-en-28-oic acid, Clethric acid, Ilex saponin A, Mussaendoside U, Mussaendoside V(Zhao et al., 1997), were isolated.

Root bark contains rotundic acid (Zhao et al., 1997; Kim et al., 1999) and possess cytotoxic activity (Yu-Fang He et al., 2012).

From the whole plant Mussaendoside O, Mussaendoside P and Mussaendoside Q(Zhao et al., 1994), Mussaendosides M and N (Jun-Ping Xu and Ren-Sheng Xu, 1992), were isolated.

Flowers contain β sitosterol (Lakshmi et al., 1985)**,** stigmasterol and doursterol (Hui et al., 1967; Lakshmi et al., 1985).

Phytoconstituents such as ursolic acid, Mussaendoside R, 3β-O-β-D-Glucopyranosyl-urs-12-en- 27,28dioicacid-28-O-β -D-glucopyranoside (Zhao et al., 1995), 3-O-β-D-Glucopyranosyl (1—>2)O-β-D-gluco pyranosyl-3 β,19α-dihydroxy-urs-12-en-28oicacid-28-O-β-D-glucopyranoside (Zhao et al., 1996)[a], aijunolic acid (Hui

et al., 1967); Mussaendoside J (Zhao et al., 1996)[a]; Mussaendoside K(Zhao et al., 1996)[b] ; Mussaendoside S (Zhao et al., 1995; Zhao et al., 1996)[c]; Mussaendoside D, Mussaendoside E and Mussaendoside H (Zhao et al., 1996)[c]; Mussaendoside G (Zhao et al., 1996)[b]. Mussaendoside A, Mussaendoside B and Mussaendoside C (Xu et al., 1991)[a], Mussaendoside M ((Xu et al., 1991[b]; Xu et al., 1992), Mussaendoside N (Xu et al., 1992). Feruic acid, caffeic acid, p-coumaric acid were also reported from the plant.

Mussaendoside F isolated from the aerial parts was found to be muscarinic antagonist (Lakshmi et al., 1985) and Anti-RSV activity with 50% inhibition(Yaolan Li et al., 2004).

The plant is said to possess antiviral activity against respiratory syncytial virus (Ruwali Pushpa et al., 2013), antifungal activity against *Rhizoctonia solani, Phytium ultimum* and *Aspergillus fumigatus* (Nugraha et al., 2011), antagonist of the M-Ach receptor and also it has hemolytic activities and immunopromotive (Xu et al., 1996).

Mussaenda queensirkit

Flowers are said to possess cytotoxic activity (Vidyalakshmi et al, 2007).

***Mussaenda raiatensis* J.W.Moore**

Phytoconstituents reported are quercetin, rutin, hyperin, ferulic acid, sinapic acid, beta sitosterol, saponin (WHO, 1998).

***Mussaenda roxburghii* Hook. F.**

From the aerial parts phytoconstituents such as iridoid, shanziol was isolated and found to possess antibacterial activity (Shylaja Gunasekaran et al., 2015).

Leaves were found to be with antimicrobial, antioxidant, anti-α-glucosidase activities (Debasish Maiti et al., 2013), **a**poptotic and antioxidant activities (Farhadul Islam et al., 2015) and cytotoxic activities (Farhana Islam et al., 2013).

***Mussaenda shikokiana* Makino**

Phytoconstituents reported were Mussaenoside and shanzhiside methyl ester (Yoshio Takeda et al., 1977).

***Mussaenda tomentosa* Wight Ex Hook. F.**

Leaves of M. tomentosa was found to be with antioxidant and antidiabetic properties (Muruganandam et al., 2016).

CONCLUSIONS

The *Mussaenda* is a rich source of pharmacologically important phytoconstituents such as triterpenes, iridoids and flavonoids. The numerous species of this genus is said to possess numerous medicinal properties such as antibacterial, anti-inflammatory, antioxidant, antipyretic, antiviral, cytotoxicity, diuretic, etc., The current updated review on the *Mussaenda genus* highlights its botanical, pharmacognostical, phytochemical and pharmacological. This updated review on the plant will be much more helpful for all those researchers who are all carrying out their investigations and research on this genus.

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