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MINI REVIEW

Jasminum multiflorum (Burm. f.) Andr.: Botany, Chemistry and Pharmacology

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Jasminum multiflorum (Burm. f.) Andr. is an ornamental plant with medicinal importance. About 14 compounds have been isolated from this herb, out of which 11 compounds are secoirridoid derivatives with coronary dilating and cardiotropic potential. This mini-review summarizes an up-date of botany, phytochemistry and pharmacology of *J. multiflorum* since year 1960 to 2015, as there is no such report available so far. The provided information on *J. multiflorum* will be helpful in the development of new leads and therapeutics, especially in the area of cardioprotection.

Keywords: *Jasminum multiflorum*, Botany, Chemical constituents, Pharmacological properties.

INTRODUCTION

Jasminum is a genus of vines and shrubs of olive family (Oleaceae) distributed throughout tropical and sub-tropical countries and commercially grown for their flowers and essential oil production [1,2]. *Jasminum multiflorum* (Burm. f.) Andr., synonym *J. pubescens* commonly known as furry jasmine or downy jasmine is native to India, most commonly distributed in forests of Western Ghats and sub-Himalaya upto 1500 m, southeast Asia and some parts of Europe and Africa [3,4]. *Jasminum mutiflorum is* an evergreen ornamental plant of sprawling shrub or climber of one foot or hedge of 5 to 6 feet with velvety appearance of leaves and white flowers blooming profusely during winters and commercially cultivated for its essential oil of flowers, useful in cosmetic industry [5,6]. Flowers possess therapeutic value in folk medicine and also cultivated for religious purpose. The flowers of *J. multiflorum* are bitter refrigerant, laxative cardiotonic, alexipharmic, depurative and digestive and useful in vitiated conditions of pitta, inflammation, rheumatism and cephalalgia [7]. The leaves and flowers are reported to possess coronary vasodilating and cardiotropic pharmacological properties [8,9]. The dried leaves are used to treat indolent ulcer and juice to treat typhoid and stomach ache. Roots of the plant are emetic and used as antidote to snake venom [10,11]. Secoiridoid lactones and their glycosides are the major class of compounds reported from *J. multiflorum* [8-14].

Botany: *Jasminum multiflorum* Andr. (Sanskrit: kunda, Bengali: kundaphul, Hindi: chameli, English: star jasmine) is a large scandent, tomentose shrub with velvety pubescence. The plant is native to India and distributed throughout China, Malaysia, Taiwan, Europe and Africa [1,13]. This plant is more commonly grown as shrubs than vine and the strong woody vine climb 20 or more feet by scrambling over its support. *Jasminum multiflorum* possess almost scentless pure white flowers with 8 lobes of about an inch across with axillary clusters and bloom throughout the year. The calyx lobes are about 0.5 inch long and covered with yellow hairs [3]. Leaves are simple, opposite, acute, rounded or slightly heart shaped at base and 1-3 inches long. The young leaves and stems are hairy or pubescent.

Chemical constituents: Secoiridoids are major class of compounds reported from *Jasminum* species as well as *J. multiflorum*. The secoiridoids are derived from iridoids [a group of monoterpenes derived from iridane (*cis*-2-oxabicyclic-[4.3.0]-nonane)] by elimination of the link 7-8 to give basic structure as shown in Fig. 1 [15]. The 10-hydroxy-oleoside derivatives *e.g.* 10-hydroxyoleuropein, jusmultiside and multifloroside originated by the hydroxylation of corresponding oleoside named, oleuropein and 7-methyl oleoside derivatives that can be esterified at C-11 and hydroxylated at C-10, are common in *J. multiflorum*. Shen and co-workers [12] isolated four secoiridoid lactones, jasmolactone A, B, C and D which contain novel bicyclic-2-oxo-oxepano[4,5-c]pyran ring system from leaves and flowers of *J. multiflorum*. An acetylated phenolic derivative 2-*p*-acetoxyphenylethanol along with long chain saturated compounds *n*-tritetracontane and heptacosane were reported from the flowers of *J. multiflorum* [16].

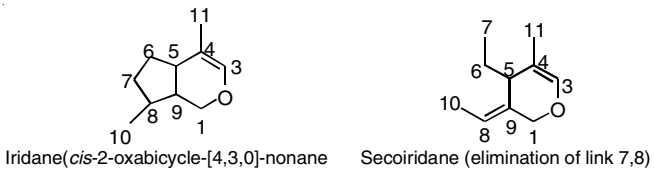
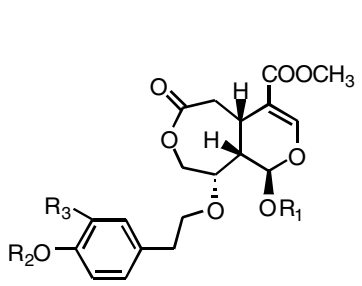


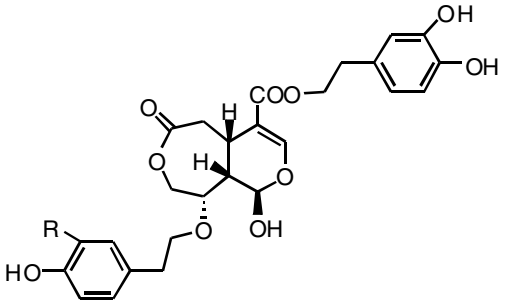
Fig. 1. Basic structure of iridoid and secoirridoid

The compounds reported from *J. multiflorum* along with their physical properties are compiled in Table-1 and the structures of chemical constituents are given in Fig. 2.

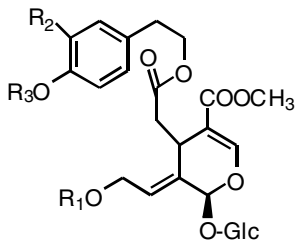
GC-MS analysis: The percentage of chemical compositions and quality of extracts depends on the technique used for the extraction. Similarly in *J. multiflorum* chemical analysis of flowers has been carried out considering two factors, harvest timing and extraction method. Ahmad and co-workers [17] reported the comparative study on the quantity and chemical composition of essential oil of the flowers harvested at morning and evening by GC-MS analysis and recommended morning harvesting for better quality jasmine oil extraction. About 200 compounds have been found from the concrete (remaining waxy



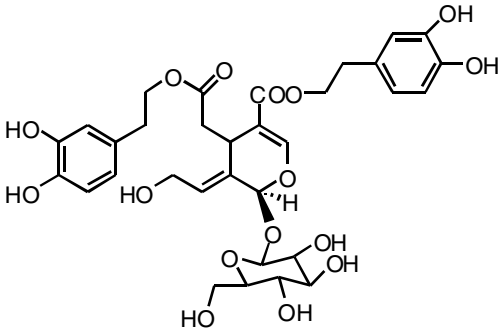
$R_1=R_2=R_3=H$; Jasmolactone A (1)
$R_1=R_2=R_3=OH$; Jasmolactone B (2)



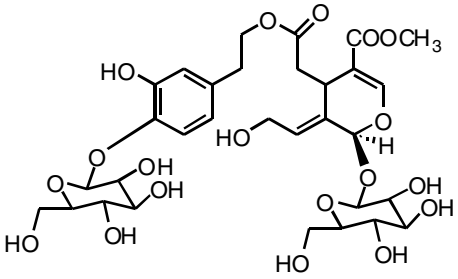
R=H; Jasmolactone C (3)
R=OH; Jasmolactone D (4)



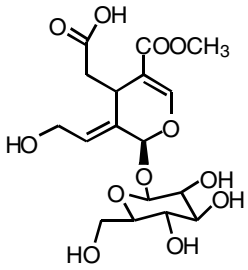
$R_1=R_3=H, R_2=OH$; 10-Hydroxyoleuropein (5)
$R_1=R_2=R_3=H$; 10-Hydroxyligustroside (6)



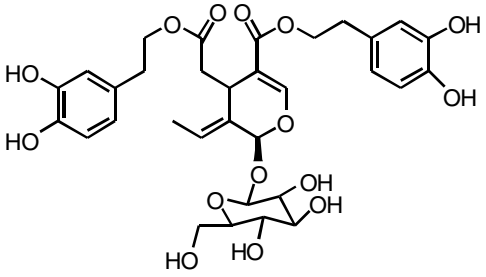
Multifloroside (7)



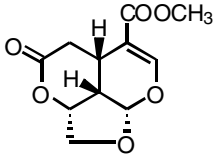
Multiroside (8)



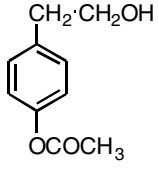
10-Hydroxyoleoside 11-methyl ester (9)



Jasmultiside (10)



Multiflorin (11)



2-*p*-Acetoxyphenylethanol (12)

Fig. 2. Structure of chemical constituents of *J. multiflorum*

TABLE-1
CHEMICAL CONSTITUENTS OF *J. multiflorum*

S. No.	Compound/Plant parts	Physical properties	Ref.
1	Jasmolactone A (Ap)	Pale yellow solid; $[\alpha]_D$ +122.4° ($CHCl_3$); UV (MeOH) λ_{max} 200, 226, 277 nm; $C_{19}H_{22}O_8$; $[M]^+$ 378	[12]
2	Jasmolactone B (Ap)	Amorphous; $[\alpha]_D$ +100.1° (MeOH); UV (MeOH); λ_{max} 201, 226, 280 nm; $C_{19}H_{22}O_9$; $[M]^+$ 394	[12]
3	Jasmolactone C (Ap)	$[\alpha]_D$ +48.6° (MeOH); UV (MeOH) λ_{max} 203, 223, 279 nm; $C_{26}H_{28}O_{10}$; $[M]^+$ 500	[12]
4	Jasmolactone D (Ap)	Powder; $[\alpha]_D$ +28.5° (MeOH); UV (MeOH) λ_{max} 202, 224, 281 nm; $C_{26}H_{28}O_{11}$; $[M]^+$ 516	[12]
5	10-Hydroxyloeuropein (Ap)	Powder; $C_{25}H_{32}O_{14}$; $[M]^+$ 556	[14]
6	10-Hydroxyligustroside (Ap)	Amorphous powder; $[\alpha]_D$ -172.3° (EtOH); UV (MeOH) λ_{max} 203, 226, 277 nm; $C_{25}H_{32}O_{13}$; $[M]^+$ 540	[13]
7	Multifloroside (Ap)	Pale yellow powder; $[\alpha]_D$ -40.9° (MeOH); UV (MeOH) λ_{max} 204, 224, 282 nm; $C_{32}H_{38}O_{16}$; $[M]^+$ 678	[13]
8	Multiroside (Ap)	Powder; $[\alpha]_D$ -108.6° (MeOH); UV (MeOH) λ_{max} 203, 226, 276 nm; $C_{31}H_{42}O_{19}$; $[M]^+$ 718	[13]
9	10-Hydroxyoleoside 11-methyl ester (Ap)	Powder; $[\alpha]_D$ -113.3° (MeOH); UV (MeOH) λ_{max} 201, 235 nm; $C_{17}H_{24}O_{12}$; $[M]^+$ 420	[13]
10	Jasmultiside (Ap)	Powder; $[\alpha]_D$ -42.6° (MeOH); UV (MeOH) λ_{max} 223, 281 nm; $C_{32}H_{38}O_{15}$; $[M]^+$ 662	[14]
11	Multiflorin (Lf and Fl)	Colourless needles; $[\alpha]_D$ 110° ($CHCl_3$); UV ($CHCl_3$) λ_{max} 234 nm; $C_{11}H_{22}O_6$; $[M]^+$ 240	[8]
12	2-*p*-Acetoxyphenylethanol (Fl)	Viscous solid; $C_{10}H_{12}O_3$; $[M]^+$ 180	[16]
13	*n*-Tritetracontane (Fl)	Low melting solid; m.p. 40 °C; $C_{43}H_{88}$; $[M]^+$ 604	[16]
14	Heptacosane (Fl)	Low melting solid; m.p. 40 °C; $C_{23}H_{56}$; $[M]^+$ 380	[16]

mass after extraction), out of which only 70 compounds were identified by GC-MS. The analysis results showed, harvest time does not affect the quantity of the concrete extract however significantly affects the chemical composition. The characteristic compounds present in the oil of flowers of *J. multiflorum* were indole (0.11 %) and *cis*-jasmone (0.01 %) along with aroma bearing compounds benzyl alcohol (13.85 %), linalool (4.92 %) and benzyl acetate (1.24 %) and found to be higher in morning harvested flowers. Whereas other aroma bearing chemical constituents like eugenol (0.15 %), benzyl benzoate (0.69 %), farnesol (7.01 %), methyl palmitate (0.21 %) and methyl salicylate (0.42 %) were present in higher concentration in evening harvested flowers.

Another GC-MS analysis was carried out to identify the chemical constituents of flowers of *J. multiflorum* extracts prepared by different extraction techniques like solvent extraction/maceration (methanol), hydrodistillation and headspace solid phase microextraction (HS-SPME) [7]. The GC-MS analysis quantitatively detected main peaks of oxygenated sesquiterpenes, esters and carbonyl compounds from methanol extract whereas esters, oxygenated and non-oxygenated sesquiterpene from hydrodistillation method and oxygenated sesquiterpene and carbonyl compounds from HS-SPME technique. The GC-MS profile of methanol extract yielded nerolidol (42.44 %), benzyl benzoate (39.00 %) and jasmolactone (12.02 %). Hydrodistillation of *J. multiflorum* flowers yielded hexenyl benzoate (35.89 %), β-farnesene (24.62 %) and cadinol (14.30 %) as main constituents. HS-SPME analysis yielded nerolidol (76.56 %), jasmine (15.31 %) and hexyl benzoate (4.40 %). The GC-MS analysis concluded that flowers of *J. multiflorum* are rich in nerolidol, benzyl benzoate, jasmolactone, jasmine, hexenyl benzoate and β-farnesene.

Pharmacological properties of extracts and chemical constituents: The reported pharmacological properties of *J. multiflorum* extracts and compounds are presented in Table-2.

Cardiovascular activity: In Ayurvedic system of medicine flowers of *J. multiflorum* is reported as cardiotonic. Somanadhan and co-workers [9], evaluated water, acetone and ethanol extracts of leaves and flowers of *J. multiflorum* for inhibitory activity of angiotensin converting enzyme (ACE) to investigate its cardiotonic potential and water extract was found to inhibit 92 % of angiotensin converting enzyme. The secoiridoids glycoside, 10-hydroxyoleuropein and multifloroside isolated from aerial parts of *J. multiflorum* exhibited strong coronary dilating and cardioprotective (negative inotropy) activities on isolated guinea pig preparations. The minimum effective concentration (MEC) of 10-hydroxyoleuropein for coronary dilating and cardioprotective activities was 9.0×10^{-6} M (both activities) whereas multifloroside exhibited 3.7×10^{-6} M and 1.5×10^{-6} M, respectively [13]. Secoirridoid lactones, jasmolactone B and D reported to induces dilation (MEC 1.3×10^{-5} M and 4.8×10^{-6} M) and chronotropic and inotropic effects (MEC 2.5×10^{-5} M and 9.7×10^{-6} M) in isolated guinea pig heart coronary, using isoproterenol as standard (MEC 4.7×10^{-7} M and 4.7×10^{-8} M) [12].

Antioxidant activity: The methanolic extract of flowers of *J. multiflorum* has been reported to scavenge DPPH radicals with IC_{50} value 81 µg/mL using BHT (IC_{50} 12.5 µg/mL) as positive control and the GC-MS analysis of methanolic extract showed the presence of nerolidol, benzyl benzoate and jasmolactone as main chemical constituents [7]. The DPPH scavenging activity of *J. mutiflorum* shows that it can use as a natural reducing agent and free radical scavenger.

Toxicity of *J. multiflorum*: So far, no report available on the toxicity studies of *J. multiflorum*.

TABLE-2
PHARMACOLOGICAL ACTIVITY OF EXTRACTS AND COMPOUNDS OF *J. multiflorum*

S. No.	Extract/compound	Activity	Ref
1	10-Hydroxy-oleuropein (Ap)	Coronary dilating and cardiotropic (negativeinotropy) activity on isolated guinea pig heart preparations using Langendorff apparatus, Minimum effective concentration (MEC 9.0×10^{-6} M for both activities)	[13]
2	Multifloroside (Ap)	Coronary dilating and cardiotropic (negativeinotropy) activity on isolated guinea pig heart preparations (MEC 3.7×10^{-6} M and 1.5×10^{-6} M respectively)	[13]
3	Jasmolactone B (Ap)	Coronary dilating (MEC 1.3×10^{-5} M) and cardiotropic activity (MEC 2.5×10^{-6} M) on isolated guinea pig heart preparations using isoproterenol (MEC 4.7×10^{-7} M and 4.7×10^{-8} M respectively) as standard with marginal anti-arrhythmic activity	[12]
4	Jasmolactone D (Ap)	Coronary dilating (MEC 4.8×10^{-6} M) and cardiotropic activity (MEC 9.7×10^{-6} M) on isolated guinea pig heart preparations using isoproterenol (MEC 4.7×10^{-7} M and 4.7×10^{-8} M respectively) as standard with marginal anti-arrhythmic activity	[12]
5	Water, Ethanol and acetone (Fl)	Cardiotonic	[9]
6	MeOH (Fl)	Antioxidant activity (IC_{50} 81 µg/mL) to scavenge DPPH radicals using butylated hydroxyl toluene (BHT) (IC_{50} 12.5 µg/mL) as positive control	[7]
7	Ethanol (Ap)	Showed central nervous system (CNS) depressant activity by combined effects of potentiating sleeping time of mice induced by standard hypnotics pentobarbitone sodium, diazepam and meprobamate; analgesic activity by reducing writhes and stretches induced by acetic acid in mice and anticonvulsant activity induced by pentylene tetrazole	[10]
8	Petroleum ether, chloroform and methanol (Lf)	Antioxidant activity at 500 µg/mL concentration of petroleum ether (59.40 %), chloroform (77.28 %), methanol (81.44 %), standard ascorbic acid (97 %) using DPPH assay	[18]
9	Petroleum ether, chloroform and methanol (Lf)	Antimicrobial activity, methanol extract possess strong antifungal and antibacterial activity	[19]
10	Aqueous (Lf and St)	Nematicidal effect (*in vitro*) against *Meloidogyne incognita* second stage larvae showed more than 50 % larval mortality	[20]

Ap = Aerial part; Fl = Flower; Lf = Leaf; St = Stem

Conclusion

The present review on *J. multiflorum* is a compilation of chemistry and pharmacological activities of extracts and compounds. So far, only 14 compounds have been reported to till date. Iridoids were found as major class of compounds present in *J. multiflorum* and characteristic to other *Jasminum* species as well. The extracts and chemical constituents of *J. multiflorum* have been reported for antioxidant, coronary dilating, cardiotropic and nematicidal properties. The antioxidant activity of flowers and presence of nerolidol, benzyl benzoate, jasmolactone, jasmine, hexyl benzoate and β-farnesene as major chemical constituents in its essential oil showed *J. multiflorum* can be used as natural preservative in food, flavouring and pharmaceutical industry. The literature study on *J. multiflorum* reveals, only few reports available on chemistry and pharmacological activities and need to explore the chemical, pharmacological (extracts/fractions and isolated compounds), analytical and clinical aspects. However the biological active constituents needed to explore further to evaluate for their pre-clinical studies and other bio-assays. Future studies on *J. multiflorum* will be helpful for the emergence of less explored herb to a valuable medicinal plant with new leads for drug discovery.

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