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Secoiridoids from *Jasminum* Species- A Report

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Abstract : The genus Jasminum has been a source of various traditionally useful and pharmacological active species. Many plants of this genus prominently feature white, yellow or pink flowers with sweet fragrance and others are unscented. The species are cultivated for flowers containing bioactive compounds especially iridoids, secoiridoids and essential oils. The pharmacological effects evaluated from the crude extracts or pure isolated compounds from these species have been antimicrobial, antifungal,antiviral, insecticidal, antioxidant, anti-inflammatory antioxidant, antimicrobial, anthelmintic, antiulcer, antidiarrhoea and analgesic activities. Secoiridoids are cyclopentane mono-terpene derivatives formed by cleavage of the cyclomethene oxime compounds at C-7 and C-8. Nearly 250 secoiridoids in the form of aglycones, dimers and derivatives have been identified from Oleaceae family. The secoiridoids from *Jasminum* species are studied in this report. The chemical compounds isolated from these species have been reported for their pharmacological effects. Although, few experimental studies validated their traditional claim, but uncharacterized crude extracts were employed in most of the activities. Such species need to be explored properly for their bioactive principle and exploited as potential drug.

IndexTerms - Jasminum officinale, Jasminum mensyi, Jasminum amplexicaule, Jasminum multiflorum.

I. INTRODUCTION

Herbal plants are pioneer for new drug discovery and development, not only for plantconstituents used directly as therapeutic agents, but also as precursor for half of the clinical drugs available in the market [1]. The herbal plants are used for the prevention and treatment of various ailments in the developing countries due to their availability to the native people and heavy cost factor of clinical drugs.

Oleaceae is a family of dicotyledonous flowering plants which is widely distributed in the temperate and tropical regions. This family includes 25 genera with approximately 688 species [2]. The *Jasminum* is the major genus of *Oleaceae* and an important group of flowering plants, commonly cultivated for their aromatic flowers . There are 197 taxonomically recognized species of the genus *Jasminum* in the world [3]. *Jasminum* plants have been recommended against intestinal worms and venereal diseases [4]. Notably, in the aspect of medicine and pharmaceutical sectors, almost all parts of the plant are important. Flowers are used for treating vesicles, ulcers, skin diseases, boils, and eye disorders, while leaves are used against breast tumors [5]. Traditionally, many members of the *Jasminum* genus have been used medicinally. For instance, *J. officinale* exhibits various therapeutic properties, viz., depurative, analgesic, diuretic, antiseptic, expectorant, anti-depressant, and sedative [6]. It is used by native and nomadic communities for treating gastrointestinal disorders, cough, pyrexia, eye inflammation, and also against irregular menstruation [7]. Likewise, *J. grandiflorum* is recommended against cough, hysteria, uterine ailments, and partum problems [8]. Subsequently, *J. sambac* is expectorant, analgesic, antiseptic, aphrodisiac, anti-depressant, and sedative [9]. The powder of its twigs and leaves of *J.amplexicaule* has been used as a hydragogue and a febrifuge and also has been used as a kind of traditional medicine for the treatment of dysentery, diarrhoea and bellyache in China. The leaves of *J. polyanthum* were grind into juice and treated for urinary tract infections as sedative, mild anesthetic and astringent. Jasmine species also finds place in cosmetics and used for making perfumes and scents. Flowers are used for skin conditioner and used in shampoos, soaps, creams etc. Phytochemical investigations have revealed that the main chemical constituents from this family are flavonoids, monoterpenoids, iridoids, secoiridoids and phenylethanoid glycosides. The pharmacological reported reported from Jasminum species are antimicrobial, antioxidant, anti-inflammatory, antifungal, antiviral, insecticidal, anthmintic, antiulcer, antidiarrhoa and analgesic.

Secoiridoids are cyclopentane mono-terpene derivatives formed by cleavage of the cyclomethene oxime compounds at C-7 and C-8. Nearly 250 secoiridoids in the form of aglycones, dimers and derivatives have been identified from Oleaceae family. These compounds are mainly distributed in the genera- *Fontanesia, Fraxinus, Jasminum, Ligustrum, Olea, Osmanthus, Phillyrea, Picconia* and *Syringa* [10]. Secoiridoids have shown a variety of pharmacological effects including anti-diabetic, anti-inflammatory, immunosuppressive, neuroprotective, anti-cancer and anti-obesity. Keeping in view this work was undertaken for the structural and pharmacological aspects of secoiridoids from the species- *J. officinale, J. mensyi, J. amplexicaule, J. multiflorum, J. sambac* and *J. polyanthum*. The data was withdrawn from Google Scholar, PubMed, Science Direct, Scopus, Krishikosh and Shodhganga.

Chemistry of Secoiridoids: Secoiridoids are cyclopentane mono-terpene derivatives formed by cleavage of the cyclomethene oxime compounds at C-7 and C-8. Nearly 250 secoiridoids in the form of aglycones, dimers and derivatives have been identified from Oleaceae family. These compounds are mainly distributed in the genera- *Fontanesia, Fraxinus, Jasminum, Ligustrum, Olea, Osmanthus, Phillyrea, Picconia* and *Syringa* [10]. These secoiridoids were classified into 5 groups namely, simple secoiridoids,

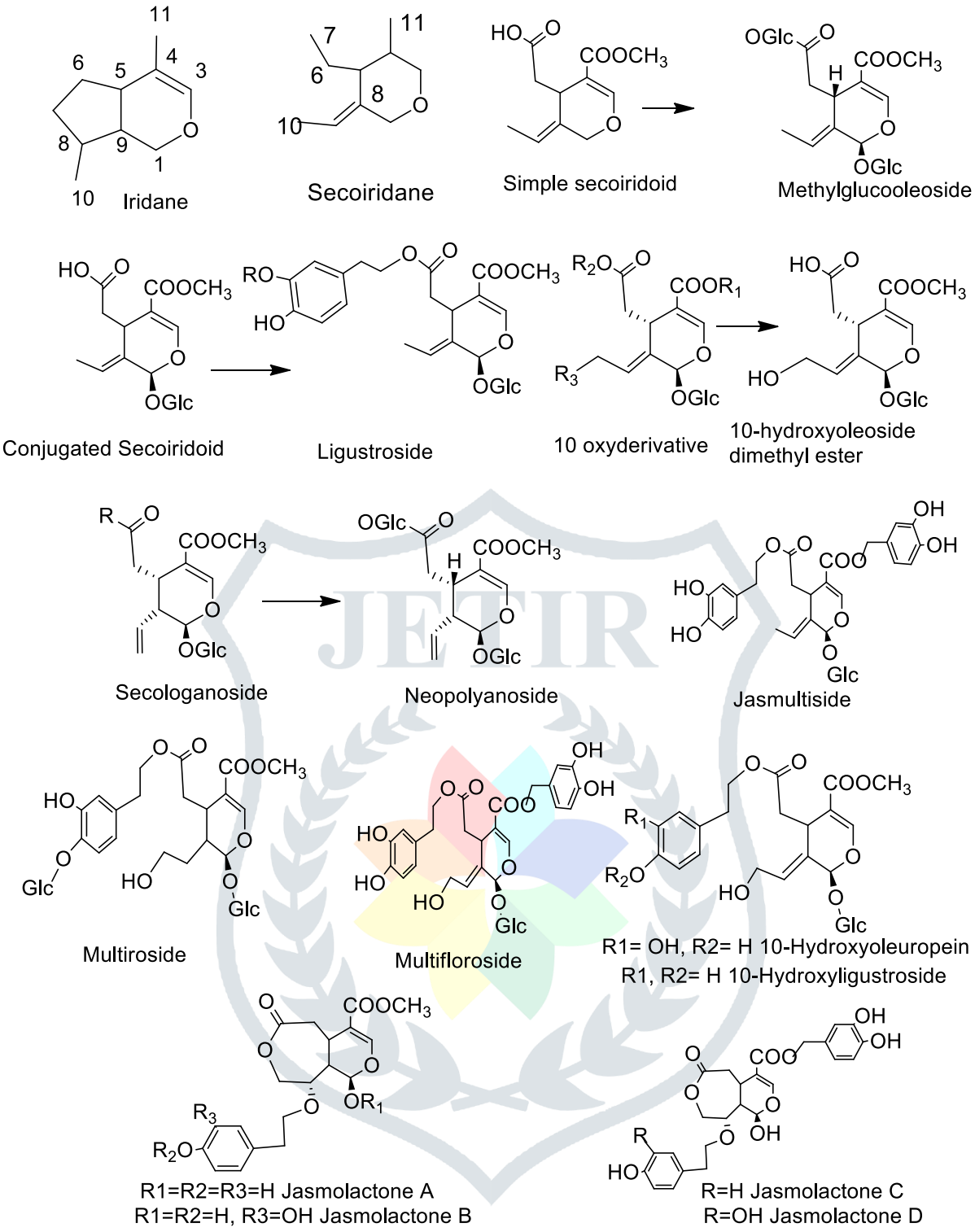

Fig -1 Structures of Secoiridoids from Jasminum Species.

conjugated secoiridoids, 10-oxyderivative of oleoside secoiridoids, Z-secoiridoids, secologanosides [11,12]. The substitution at different position of basic skeleton derive diverse compounds. The structures of the secoiridoids in the order of classification is summarized as-(Fig-1)

a) Simple secoiridoids-Generally, in the simple secoiridoids (Table-1) positions C-7 and C-11 have either a free carboxylic acid group or a methyl ethyl ester derivative of the acid. In addition, the configurations of positions C-1 and C-5 are S. e.g. methylglucooleoside.

b) Conjugated secoiridoids- This group of compounds constitute the majority of secoiridoids isolated from the *Oleaceae* family and *Jasminum* . The name of the class stems from the type of compound that is linked or conjugated to the secoiridoid nucleus. The C-7 position is usually oxidized to a carboxylic acid and esterified with different groups. The double bond between the C-8 and C-9 positions and the hydrogen at the C-8 position is replaced by a methyl group. Also, most of the aromatic-

Table –1 Secoiridoid from *Jasminum* Species.

Species	Secoiridoid Compounds	References.
Jasminum polyanthum	Jaspolyside, Oleoside 11-methyl ester, Oleoside dimethyl ester, methylglucooleoside, Ligustroside, Angustifolioside B, Oleopein, GIS, Jaspolyoleoside A, Oleoacetoside, Jaspofoliamoside A, Jaspofoliamoside B, Jaspofoliamoside C, Jaspofoliamoside D, Jaspofoliamoside G, Jaspolinaloside, Jaspogeranoside A, Jaspogeranoside B, Isojaspolyoside A, Isojaspolyoside **B**, Isojaspolyoside C, Polyanoside, Jaspolyoleoside B, Jaspolyoleoside C,Jaspolyoside, Jaspofoliamoside E, Jaspofoliamoside F, Jaspolinloside B, 10-Hydroxyoleoside dimethyl ester, Oleopolyanthoside B, Oleopolyanthoside A, Jaspolyanthoside.	[13,14,15,16]
J. sambac	Sambacolignoside, Oleoside dimethyl ester.	[17]
J. nudiflorum	Isooleoacteoside, Jasnudifloside F, Jasnudifloside K, Jasnudifloside G, Nudifloside D, Jasnudifloside J, Nudifloside C, Jasnudifloside I, Nudifloside A , Jasnudifloside L, Jasnudifloside H, Jasnudifloside A, Jasnudifloside E, Jasnudifloside D, Jasnudifloside B, Nudifloside B, Jasnudifloside C.	[18]
J. urophyllum	Jasuroside E, Jasuroside F, Jasuroside A, Jasuroside C, Jasuroside B, Jasuroside D, Jasurolignoside, 10-Hydroxyoleoside dimethyl ester, Jasminoside.	[19,20]
J. mesnyi	9- Hydroxyjasmesoside, 9- Hydroxyjasmesoside acid, Jasmesoside, Isojasminin, 4”-Hydroxyisojasminin, Jasmisnyiroside, Jasminin, 2”-Hydroxyjasminin, Jasminin 10”-*O*-β-D-glucoside, Jasmoside, Jasmosidic acid.	[21,22]
J. lanceolarium	10-Hydroxyoleoside-11-methyl ester, 10-Hydroxyoleoside dimethyl ester, Jaslanceoside F, Jaslanceoside H, Jaslanceoside G, Jaslanceoside A, Jaslanceoside C, Jasminoside , Jaslanceoside B, Jaslanceoside D, Jaslanceoside E.	[23,24]
J. multiflorum	Multiroside, 10-Hydroxyoleuropein, 10-Hydroxyoleoside-11-methyl ester, 10-Hydroxyligustroside, Multifluoroside.	[25]
J. odoratissimum	10-Hydroxyoleoside dimethyl ester, 10-Acetoxyoleoside dimethyl ester, *trans*-10-(p-coumaroyloxy) oleoside dimethyl ester, *cis*-10-(p-coumaroyloxy) oleoside dimethyl ester, 6’-*O*-Acetyl-10-acetoxyoleoside.	[26]
J. amplexicaule	10-Hydroxyligustroside, Jasamplexoside A, Jasamplexoside C, Jasamplexoside B, Jasminoside.	[27]
J. officinale	Secoiridoids glucosides-[20R]-20-methoxyoleuropein, [20S]-20-methoxyoleuropein,oleuropein, ligstroside, demethyloleuropein and oleoside dimethylester. jasgranoside, jaspolyoside,8-epi-kingiside, 10-hydroxy-oleuropein,10-hydroxy-ligstroside and oleoside-7, 11-dimethyl ester.	[28,29]
J. abyssinicum	Craigoside C, Craigoside B, Craigoside A,	[30]

conjugated secoiridoids are also oxidized to carboxylic acids at the C-11 which may either be free or esterified with either 1,2-dihydroxyphenylethanol or p-hydro-xyphenylethanol. e.g. ligustroside [10].

c) 10-Oxyderivative of oleoside secoiridoids- This class possesses the oleoside nucleus with distinct structural differences. The C-8 and C-9 positions exist as double bonds and the hydrogen at the C-8 position is replaced by a hydroxy group or an ester is formed by an oxygen atom with different groups. These groups typically include an acetyl and phenolic moieties. A total of 40 10-oxyderivative of oleoside secoiridoids. e.g. 10-hydroxyoleoside dimethyl ester [10].

d) Secologanosides and oxidized secologanoside secoiridoids-Majority of compounds in this class are based on the secologanoside nucleus. The unique structural features of this class are the position of the carbon-carbon double bond is between C-8 and C-10 in most compounds and the level oxidation of C-10.Forty-four secologanosides and oxidized secologanoside glycosides have been isolated from the Oleaceae family and genus- *jasminum*. e.g. neopolyanthoside [10].

Secoiridoids from *Jasminum* species:

Various secoiridoid to the class simple, conjugated, 10-oxyderivative, secologanoside and oxidized secologanoside are isolated from different species of *Jasminum*. These are summarized as-

Jasminum polyanthum: *J. polyanthum* the many-flowered jasmine or pink jasmine is a species of flowering plant native to China and Myanmar. It grows well in subtropical climate [31]. Flowers are used for skin conditioner and cosmetic purposes. Flowers were used as folk remedy for hepatitis, stomatitis, and duodenitis in china, Jasmine flowers are also used for decorative purpose [32]. Secoiridoids compounds are isolated as major constituents from leaves and flowers of *Jasminum polyanthum*. Leaves- jaspolyside, oleoside-11-methyl ester, 7,11oleoside dimethyl ester methylglucooleoside, augustifolioside, oleuropein, isonuezhenide [13]. Flowers- jaspolyoside, jaspolyanthoside, GI5[14], augustifolioside, isojaspolyoside A, isojaspolyoside B, isojaspolyoside C, polyanoside [15], jaspolyoleoside A , jaspolyoleoside B, jaspolyoleoside C, oleopolyanthoside A, oleopolyanthoside B [16], jaspofoliamoside C, jaspofoliamoside D, jaspogeranoside A, jaspogeranoside B, jaspofoliamoside G, jaspofoliamoside E, jaspofoliamoside F, jaspolinaloside B, jaspofoliamoside B, jaspofoliamoside A, jaspolinaloside, neopolyanthoside [16].

Jasminum multiflorum*: Jasminum multiflorum* is native to India distributed in forests of Western Ghats and sub-Himalaya range upto 1500 m, southeast Asia and throughout China, Malaysia, Taiwan, Europe and Africa [33]. *J. multiflorum* is an evergreen ornamental plant of velvety appearance.Commercially cultivated for its flowers and constituents useful in cosmetic industry.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 [34]. The leaves and flowers are reported to possess coronary vasodilating and cardiotropic pharmacological properties [35]. 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. The major chemical compounds reported from this species are secoiridoids derived from iridoid based bicylclic ring iridane opening at 7-8 position. The aqueous extract of J. multiflorum derived secoiridoid glycosides-multifloroside, mutiroside, 10-hydroxy-oleoside-11-methyl ester, 10-hydroxyoleuropein, 10-hydroxyligustroside, jusmultiside, multiflorin [25]. Secoiridoid lactones- jasmolactone A, B, C and D [36]. Derivatives - jasmultiside was acetylated to derive jasmultiside octacetate. Methylation and acetylation of mulifloroside was performed to prepare 10-hydroxyoleoside 7, 11-dimethyl ester pentaacetate identical derivative of 10-hydroxyligustroside [28]. Multiroside was derived to prepare 10-hydroxyoleoside 11-methyl ester pentaacetate. 10-hydroxy-oleoside-11-methyl ester have been directly acetylated to pentaacetate acid. An acetylated phenolic derivative 2-p-acetoxy phenyl ethanol along with long chain saturated compounds n-tritetracontane and heptacosane were reported from the flowers of *J. multiflorum* [29].

Jasminum sambac (Arabian jasmine, Indian jasmine, Sampaguita, Mogra) is the national flower of Philippines, distributed throughout gunda mallige in India, moli in China, pikake in Hawaii and Arabian jasmine in the mainland USA. It is commercially grown in India, Thailand, China and Philippines [37]. Roots are used to treat wounds and snake bites. The leaves and flowers have antipyretic and decongestant properties. The flowers are used for treatment of diarrhea, abdominal pain, conjuctivitis and dermatitis. The leaves and roots are used for treating diarrhoea, fever, pain and as an anesthetic [38]. The flowers of *J. sambac* are used as flavor for tea leaves to provide a characteristic jasmine impact. The phytochemicals from *Jasminum sambac* contain iridoidal glycosides, linalyl 6-O-malonyl-β-D-glucopyranoside, benzyl6-O-β-D-xylopyranosyl-β-D-glucopyranoside (β-primeveroside), 2-phenylethyl β-primeveroside, 2-phenylethyl 6-O-α-L-rhamnopyranosyl-β-D-glucopyranoside (β-rutinoside) [39]. The compounds isolated from leaves contain sambacosides A, E and F and flowers contain molihuaside A-E, sambaeoside A [40].

Jasminum officinale- The species is native to Asia continent including the countries Georgia, China, Tajikistan, Afghanistan, Iran, Iraq, Turkey, Bhutan, India, Nepal and Pakistan [41]. The plants of *Jasminum officinale* have been widely preserved and cultivated for the attractive and fragrent flowers. Leaves are chewed for the treatment of aphthous, stomatitis, toothache and ulcer in the mouth. Leaf juice or oil has been dropped into the ear. The fresh juice from the leaves is used to cure sort corns between the toes, for ulceration in the mouth, throat and gums. *Jasminum officinale* was also used for the treatment of the urinary tract infections, as CNS depressant, sedative, mild anesthetic and astringent agents [42]. In addition, it was used in depression, nervous exhaustion and stress related conditions. The species has also been used to treat catarrh, coughs, laryngitis, dysmen orrhoea, labor pains, uterine disorders, skin problem such as dry, greasy, irritated, sensitive skin, and for muscular spasms and sprains . The buds of *Jasminum officinale* are used as a folk remedy for the treatment of hepatitis, dysmenorrhea, stomatitis, and duodenitis in South China. Chemical analysis of the bud of the flowers of *J. officinale* revealed the presence of Six iridoid glycosides were identified from the buds of *J. officinale* jasgranoside B, 6-O-methy-catalpol, deacetyl asperulosidic acid, aucubin, 8-dehydroxy shanzhiside and loganin[43]. Secoiridoid glucosides: [20R]-20-methoxyoleuropein, [20S]-20-methoxyoleuropein, oleuropein, ligstroside, demethyl- oleuropein. and oleoside dimethyl ester, a lignan, [2]-olivil and p-hydroxyphenethyl alcohol were isolated from the dried leaves of Jasminum officinale. Six secoiridoids were identified in the flowers of *J. officinale* included jasgranoside, jaspolyoside, 8-epi-kingiside, 10-hydroxy-oleuropein,10-hydroxy-ligstroside and oleoside-7, 11-dimethyl ester[44].

Jasminum mensy The species *Jasminum mensy* is distributed in India and Nepal. It is commonly known as Primrose Jasmine, Unnanobai in Japan, Pahari butti, Peeli chameli, Peeli malti in the villages of Himachal Pradesh, India. It is ever green rambling shrub with long and lean stems that scale up as rambling creeper [45]. Leaves of this species are used in diabetes, pyorrhea, oral sores, muscular pain, gastric disturbance and CNS disorder. Branchlets are useful in migraine, spinal pain, joint displacement, and menstrual disorder and flowers are used to treat hepatic disorder. In veterinary, leaves are used as vermifuge, galactagogue and ruminant stomach problems. Flowers are used medicinally in aroma therapy for stress, anxiety, depression and are used to treat rashes and minor irritations [46]. The roots of the plant posses wound healing potential. The secoiridoids isolared are - 9-Hydroxyjasmesoside, 9- Hydroxyjasmesoside acid, Jasmesoside, Isojasminin, 4”-Hydroxyisojasminin, Jasmisnyiroside, Jasminin, 2”-Hydroxyjasminin, Jasminin 10”-*O*-β-D-glucoside, Jasmoside, Jasmosidic acid [21,22].

Jasminum amplexicaule **Buch.-Ham** Species is distributed in Sikkim, Bhutan, Khasia, South India to Hongkon. The powder of its twigs and leaves has been used as a hydragogue and a febrifuge and also has been used as a kind of traditional medicine for the treatment of dysentery, diarrhoea and bellyache in China. Its leaves are used to take care of the quadriplegia-gall and also mixed with other ingredients to cure dysentery and bellyache [17].

Secoiridoid glucoside, Caffeic glycoside and flavnoids are mainly isolated from the leaves. Numerous glucosides has been isolated from methanolic extract of leaves such as jasminin, jasmoside, jasmesoside, oleuropein, oleoside, secologanin, 9”hydroxyjasmesoside, 9”- hydroxyljasmesosidic acid, sambacoside, jasminin, 10”-O-β-D-glucoside[27], Secoiridoid glucisides-Jasamplexosides A, B C, 10- hydroxyligstroside and Jasminoside [48].

Jasminum nudiflorum

J. Nudiflorum is a climbling shrub that predominantly thrives in temperate biome. It originates from South East Tibet to Central China[Gansu Sheng, Shaanxi Sheng, Sichuan Sheng, Xizang Zizhiqu (s.e.), Yunnan Sheng (n.w.)] It is popularly known as "Yingchun" in China meaning "flower that welcomes spring". This winter Jasmine could be used as ground cover for slopes or banks when planted in mass. It could also be used as tralling vine on wall and also for ornamental purposes for late winter landscapes [49]. The secoiridoids isolated from this species are - Isooleoacteoside, Jasnudifloside F, Jasnudifloside K, Jasnudifloside G, Nudifloside D, Jasnudifloside J, Nudifloside C, Jasnudifloside I, Nudifloside A , Jasnudifloside L, Jasnudifloside H, Jasnudifloside A, Jasnudifloside E, Jasnudifloside D, Jasnudifloside B, Nudifloside B, Jasnudifloside C [18].

Jasminum urophyllum

Southeast China to Taiwan(mainly South China and Central China) is the native temperate biome for the origin of J. Urophyllum [50].The secoiridoids isolated from *J.urophyllum* are - Jasuroside E, Jasuroside F, Jasuroside A, Jasuroside C, Jasuroside B, Jasuroside D, Jasurolignoside, 10-Hydroxyoleoside dimethyl ester, Jasminoside [19,20].

Jasminum odoratissimum

J. odoratissimum is a mid-green leaves and fragrant, pure yellow, star-shaped flowers native to Africa - Kenya, Tanzania, Zaire, Madeira, Canary Islands. Oil extraction is done soon after first picking in the morning. The flavouring tea is prepared from flowers [51]. The secoiridoids isolated from *J. odoratissimum* are- 10-Hydroxyoleoside dimethyl ester, 10-Acetoxyoleoside dimethyl ester, *trans*-10-(p-coumaroyloxy) oleoside dimethyl ester, *cis*-10-(p-coumaroyloxy) oleoside dimethyl ester, 6'-*O*-Acetyl-10-acetoxyoleoside [26].

Jasminum lanceolarium

J. Lanceolarium climbs on trees and slopes, dense valley forests at elevations below 2200 meters. It fins its origin in E. Asia - China, India, Assam, Myanmar, Thailand, Vietnam, Malaysia [52] . The secoiridoids isolated are 10-Hydroxyoleoside-11-methyl ester, 10-Hydroxyoleoside dimethyl ester, Jaslanceoside F, Jaslanceoside H, Jaslanceoside G, Jaslanceoside A, Jaslanceoside C, Jasminoside , Jaslanceoside B, Jaslanceoside D, Jaslanceoside E [23,24].

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