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A REVIEW ON ETHNOPHARMACOLOGY, PHYTOCHEMISTRY AND PHARMACOLOGY OF *BUDDLEJA ASIATICA*

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Keywords:

Buddleja asiatica, Buddlin, Buddlejol, Irridoid glucosides, Antioxidant activity

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ABSTRACT: *Buddleja asiatica* commonly called as butterfly bush is a tender deciduous plant. It is endemic to Asia and found in most parts of India. Traditionally it is used in the treatment of many health disorders such as inflammation, rheumatism, skin disease, malaria etc. In view of pharmacological aspect, *Buddleja asiatica* is screened for antihepatotoxic, antibacterial, hypotensive, anticancer, antifungal, antimalarial and antioxidant activities. More than 80 compounds including phenyl propanoids, flavonoids, Phenyl ethanoid glycosides, phenylpropanoid esters, non-phenolic compounds, triterpene saponins, iridoid glucosides, benzoates, triterpenoids, monoterpenes, acetogenins, steroids, shikimates as well as other trace elements have been identified in the plant. The flower has a pleasant fragrance and contains many flavonoids including apigenin, acacetin-7-O-β-D-glucoside, diosmin, rutin etc. The lanceolate leaves are rich in essential oil with tridecane, β-caryophyllene oxide, anethole and phytol as major components. This review provides morphological, ethnomedical, pharmacological and phytochemical data of the plant *Buddleja asiatica.*

INTRODUCTION: The genus *Buddleja* derived its name from the British botanist Rev. Adam Buddle, of the eighteenth century. *Buddleja* sometimes also referred as *buddleia* is commonly called as butterfly bush and contains almost 100 species that primarily belongs to the family loganiaceae [1]. *Buddleja asiatica* is a spectacular plant that occurs from this genus. It is an evergreen deciduous, plant that blooms from the month of march to june with the flowers having a pleasant odor. The plant grows very fast and has an extensive root support which allows the plant in preventing soil erosion on the slopes [2].

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In recent times people have started noticing the medicinal property of the plant which prompted us to write a review on the morphology, phytoconstituents, folklore uses and pharmacological activities of this valuable plant.

History and distribution: *Buddleja asiatica* are largely found in tropical and subtropical regions of Thailand, Vietnam, Malaysia, Indonesia, Philippines etc. as the plants are endemic to East Asian countries [3]. In 1908 the plant was first reported in Hawaii and currently the plant is recorded on all islands in and around Hawaii. It is believed to be introduced to the island intentionally as the flowers of the plants have a sweet fragrance. The mammoth growth of *Buddleja asiatica* in America must be more likely by means of regular movement of vehicles, birds, construction equipments [4] etc. In 1873, *Buddleja asiatica* was introduced into the United Kingdom. In west European countries the plant is seen as an

ornamental plant and used in perfume industries. However in Victoria (Australia), it is regarded as a potential weed [5]. Coming to India, *Buddleja asiatica* is distributed all over the hilly areas of Himalayan tracts starting from river Indus stretching eastwards towards Nepal, ascending to 3000 ft reaching West Bengal spreading downwards to eastern ghats of South India [6].

Ecology: *Buddleja asiatica* is a versatile plant that can tolerate any kind of soil. It is found in almost all kind of habitats like waste lands, in open forest edges, wet lands, coastal areas, river banks, road sides, landslide areas [7] etc. *Buddleja asiatica* adapts itself to arid or drought conditions, but the plants grow well in soils that are moist or wet. The plant prefers rich loamy soils but can thrive in sunny, sandy or partly shaded areas. The survival rate of the plant is high in well-nourished soils, but can grow in nutritionally poor soil also. The plant typically grows well in neutral or slightly acidic soil with a minimum support from basic (alkaline) soil [7]. The plant can tolerate high amount of atmospheric pollution.

Cultivation: *Buddleja asiatica* spreads quickly, with aggressively taking over many endemic plants. It has become widespread and locally abundant. The growth and survival of *Buddleja asiatica* is by natural ways. The plant has numerous winged seeds that are carried away by wind, bees, and butterflies over a wide area of places thereby dispersing the plant in large scale [8]. Besides that, the plant can also reproduce asexually by vegetative fragmentation. In case of proper planting and cultivation, the brown seeds of the plant are sown in bed of soil and watered. In four to five weeks the seeds start to germinate. Once the saplings are 2m tall they are kept in plastic pots. These can be raised in about four months at lower altitudes [9]. Another method of propagation of plant is by using side-shoot cuttings [10]. The taxonomical classification of *Buddleja asiatica* is mentioned in **Table 1**.

TABLE 1: TAXONOMICAL CLASSIFICATION OF *BUDDLEJA ASIATICA*

Taxonomical classification	
Kingdom	Plantae
Subkingdom	Tracheobionta
Division	Magnoliophyta
Class	Dicotyledons
Subclass	Asteridae
Family	loganiaceae

Scientific name: *Buddleja asiatica* Lour (Buddleia)

Synonym: *Buddleja neemda* Ham. ex Roxb.

Common Names: Dogtail, Asian Butterfly Bush.

Vernacular names:

Indonesia	Jugul, Daun putihan, Kayu saludang
China	Bai bei feng, Bai yu wei
Vietnam	B[oj] ch[os], T[us]y ng[uw] th[ar]o
Philiphines	Malasambung
India	Hindi: Neemda, dhurbana Bengali: Newarpati, bhimsenpati Kannada: Karakan, karakani

Description:
Buddleja asiatica is an erect evergreen shrub or small tree growing up to the height of 1–5m. The tree is trichotomously branched and has a bark that can be peeled.

Leaves: Leaves have a flat midrib with secondary veins that are oblique and tertiary veins which are reticulate. They are up to 15 cm long with opposite or alternate arrangement near the branch tips. The leaves are generally lanceolate with sharp tooth like structures in the margin followed by a tip that is sharp and pointed [11]. The dorsal parts of the leaves are green in color while the base part is whitish green. Small soft hairs are present at the base of the leaves which is very smooth to touch. The juvenile stems contain dense brown hairs.

Flowers: They appear in clusters that can grow up to 14 centimeters long. Slender flowers which are white in colour and up to 4 mm long are generally observed in the plant [11, 12]. Individual flowers are small, bell shaped, drooping and hairy with axillary and terminal spikes. The corolla tube of the flowers contains four lobes. Individual flowers are either male or female, but only one sex is to be found in one plant.

Fruit: The flowers are succeeded by brown, elliptical seed 0.8-1 X 0.3-0.4 mm, short winged at both ends. The fruits starts coming in the month of April. Fruits are oblong in shape, 4mm long and do not have hair [13].

Ethnomedical uses of *Buddleja asiatica:* The use of traditional medicines for various diseases is a

common way followed since time immemorial. From that aspect, *Buddleja asiatica* has got many interesting ethnomedicinal uses. The leaves of this plant are mixed with rice flour and used for the preparation of an alcoholic beverage called judima by tribals of Sikkim [14]. In meghalaya the flowers of the plant is cooked as a vegetable [15]. The juice of leaves and whole plant are used to treat various skin disease [16]. The leaves are also made into a paste and applied in forehead to reduce fever. In Pakistan the decoction of root barks are used for premature abortion [17]. A paste of its roots is mixed with rice water and used as a tonic to shed excessive weight gained. The stem and leaves of the plant are used as popular traditional chinese medicine for the treatment of diarrhea and articular rheumatism [18]. The whole plant *B. asiatica* has been used, to treat head tumour and malaria [19]. In Nepal the whole plant is used as an animal fodder [20]. Inspite of all this uses the plant is less utilized because of lack of scientific evidence. The ethnomedical information of the plant is given in **Table 2**.

TABLE 2: ETHNOMEDICAL INFORMATION OF *BUDDLEJA ASIATICA*

Plant parts	Uses	Ref
Leaves	Beverage	14
Flowers	Edible vegetable	15
Leaves & Root	Skin disease	16
Roots	Abortifacient	17
Leaves & Stem	Rheumatism, diarrhea	18
Wholeplant	Tumour, malaria	19
Whole Plant	Animal fodder	20

Pharmacological activities of *Buddleja asiatica:*

Occurrence of fatal diseases like cardiovascular disorder, cancer, liver disease, lung disorder, alzeimer disease etc. has become common and a significant portion of mankind succumbs to these diseases. Although curative treatments are available the search for an ideal drug continues till date. *Buddleja asiatica* with its increasing pharmacological uses may open a new window in the medicinal field. The pharmacological activities of the plant are summarized in **Table 3**.

Antibacterial activity: The whole plant of *Buddleja asiatica* was studied for its anti bacterial activity. The crude extract and various fractions like chloroform, ethyl acetate and n-butanol fractions of the plant were tested against eleven human pathogens by taking imipenem as standard drug. In the agar well diffusion method chloroform fraction of the plant was found to be most effective against the bacteria *Shigella. flexenari* and *Shigella. boydi.* The study reported that ethylacetate, and *n*-butanol fractions of *B. asiatica* inhibited gram negative bacteria to a greater extent [21]. A study was also investigated with essential oil obtained from the leaves of *Buddleja asiatica* by hydrodistillation. The oil showed the presence of many constituents including monoterpenes and sesquiterpenes. The essential oil exhibited 66% strong antibacterial activity against *Shigella boydii* [22].

Antifungal activity: Three extractions from *Buddleja asiatica* were investigated for their antifungal activity against potent fungi such as *Aspergillus flavus, Fusarium solani, Candida albicans, Trichophyton longifusus, Microsporum canis* and *Candida glaberata*. Amphotericin and miconazole were used as standard drugs. The outcome of the result was in support of chloroform extract of the plant which showed potent antifungal activity against *Aspergillus flavus, Fusarium solani* and *Trichophyton longifusus* [21]. In another study, the essential oil obtained from the leaves of this plant showed significant antifungal activity against *Aspergillus flavus* with 77% zone of inhibition [22].

Antispasmodic effect: A study investigated the spasmolytic effect of this plant in rabbit jejunum [21]. The antispasmodic effect was found to be exerted by causing blockade of calcium channel. *Buddleja asiatica* extract decreased the contractions induced by potassium ions and inhibited the spontaneous movements of jejunum. All these actions were done at concentrations 0.1, 0.3 and 1.0mg/ml respectively.

Cytotoxic activity: The methanol extract of leaves and some isolated compounds were tested for their cytotoxicity against HepG2 cells. The study reported anticancer activity exhibited by all the isolated compounds. Methanol extract and compound *E*-acteoside were reported to be most cytotoxic agent [3].

α-Chymotrypsin inhibitor activity: The ethylacetate soluble fraction of *Buddleja asiatica* was studied for its chymotrypsin inhibition activity. The study also reported the isolation of a new sterol called buddlejol. With an IC_{50} value of 12.2 ± 0.61

buddlejol was found to be a competitive inhibitor of enzyme chymotrypsin. The study supported buddlejol as a potent α-chymotrypsin inhibitor. These effective inhibitors can be used in treatment of liver disease caused by hepatitis c virus [23]. In another study *Buddleja asiatica* was investigated for its use in in the treatment of Alzheimer's disease. At an IC_{50} of 5.2 μM the essential oil obtained from the leaves of *Buddleja asiatica* showed acetylcholine esterase inhibitory activity and butyryl choline esterase inhibitory effect at an IC_{50} of 27.9 Mm [22].

Mosquitoe repellents: In order to protect us from many mosquito borne diseases like dengue, malaria etc mosquito repellents are prepared naturally as well as chemically. In an experiment conducted with various extracts from various plants of Tamilnadu, the petroleum ether extract (9% conc.) of *Buddleja asiatica* was reported to give a long lasting three hours protection from mosquito bite [24].

Hypotensive activity: A study was investigated with the methanol extract obtained from the leaves of the plant *B.asiatica*. The extract produced a constant and delayed fall of blood pressure in dog and cat which were anaesthetised by pentobarbitone. The mechanisms involved for this hypotensive response was also analysed and reported [25].

Antiinflammatory activity: A study was investigated with lipophilic extracts of *B. myriantha* stems, *B. yunanesis* stems and *B.asiatica* stems to find out their anti inflammatory effect. The study used elicited rat peritoneal leukocytes that express both cyclo-oxygenase (COX) and 5-lipoxygenase (5-LOX) activities. *B. asiatica* stems showed inhibitory activities against COX enzymes [26].

Antioxidant activity:
The 85% ethanol extract of fresh flowers of *Buddleja asiatica* was investigated for its antioxidant property. The study reported the isolation of hesperitin and hesperitin its glycoside - 7 – O – rutinoside from the flowers of *Buddeja asiatica*. The effect of hesperitin -7 – O – rutinoside on the release and inhibition of lipid peroxidase level was found to be 29.14% at 50μg and 31.52% at 100μg level. The results indicated that hesperitin -7 – O – rutinoside can act as a strong antioxidant compound [27].

Antihepatotoxic activity: Antihepatotoxic effect was carried out in male albino rats. The parts of flowers and roots were individually extracted with 95% ethanol and the extracts were administrated orally for 30 days to rats. Carbontetrachloride was used to induce hepatic injury and silymarin was taken as the standard. The results suggested that administration of ethanol extract resulted in a significant reduction in the AST and ALT level which supports the antihepatotoxic activity of the plant [28].

TABLE 3: PHARMACOLOGICAL ACTIVITIES OF *BUDDLEJA ASIATICA*

Plant parts	Type of extract	Model	Uses	Ref
Whole plant	Chloroform,ethyl acetate,n-butanol	Gram negative bacteria (*Shigella. flexenari Shigella. Boydi)*	Antibacterial.	21, 22
Whole plant	Chloroform,ethyl acetate.	*Fungi-Aspergillus flavus Trichophyton longifusus,*	Antifungal	21, 22
Whole plant	Ethyl acetate	Rabbit jejunum	Antispasmodic	21
Leaves	Methanol	HepG2 cells	Cytotoxicity	3.
Whole plant	Ethylacetate	Enzyme-α chymotrypsin	Inhibitor of αchymotrypsin.	23
Whole plant	Ethylacetate	Not stated	Mosquitoe repellent	24
Leaves	Alcohol	Cat, Dog	Hypotensive	25
Stem	Lipophilic	Rat peritoneal leucocytes	Antiinflammatory	26
Flowers	Ethanol	Whole blood from goat	Antioxidant	27
Flowers and roots	Ethanol	Rat	Antihepatotoxic	28

Phytoconstituents in *Buddleja asiatica:*
Phenyl ethanoid glycoside: Chromatographic separation of methanol extract of leaves of *Buddleja asiatica* lead to the isolation of three phenyl ethanoid glycosides. The compounds were identified as 3,4dihydroxy phenylethyl alcohol 8-O[(4'-O-feruoyl)-α-Lrhamnopyranosyl-(1"→3') –β-D-glucopyranosyl-(1'"→6')]- β-D-glucopyranoside,

E-acteoside, *E*iso acteoside and verbacoside. The structures of all the compounds were confirmed by spectroscopic methods like UV, ESI-MS and 1H, 13CNMRspectra. The isolated compounds were tested for their cytotoxic activity against a HepG2 cell line. It was found that phenyl ethanoid called E-acteoside exhibited maximum activity [3].

Sterols: Chromatographic resolutions of ethyl acetate soluble fraction of *B.asiatica* whole plant showed the presence of compounds like lignoceric acid stigmasterol taraxerol and α-amyrin. The study reported the isolation of all the identified compounds along with a new sterol, Buddlejol [23]. The structure of Buddlejol was determined as (24S)-stigmast-5, 22-diene-7b-ethoxy-3b-ol. Steroids (lignoceric acid, stigmasterol, taraxerol, α amyrin, stigmasterol-*O*-glucoside, *β*-sitosterol-*O*-glucoside) were also isolated from the defatted alcoholic extract of the flowering parts of *Buddleja asiatica.*

Iridoid glucoside: Column chromatography of the defatted alcoholic extract of the flowering aerial parts of *Buddleja asiatica* resulted in the isolation of some compounds including four steroids, two phenylpropanoids namely isoacteoside and acteoside, one triterpene saponin called mimengoside A and two flavonoids. A new iridoid glucoside named 6 – *O* - (3'', 4''-dimethoxy cinnamoyl) catalpol, was isolated from the plant [28]. Other known iridoid glucosides like methylcatalpol, catalpol, aucubin were also isolated.

Essential Oil Components: Steam-distillation of fresh aerial parts of *B. asiatica produced* essential oils which contained n-tridecane (55.87%), 5-methylundecane (10.62%), *n*-dodecane (2.84%) and *n*-hexadecanol (2.76%) as the major constituents. Another study on the essential oil composition of *B. asiatica* leaves reported β-caryophyllene oxide (21.7%), citronellol (16.7%) and *β*-caryophyllene (15.8%) as major components [29].

Phenylpropanoid esters: New phenylpropanoid esters of rhamnose collectively called as asiatisides A – D were isolated from the aerial parts of *Buddleja asiatica.* The methanol extract of air dried aerial parts were subjected to column chromatography which led to the isolation of unknown esters like 3-O-acetyl-4-O-(p-methoxycinnamoyl)-a-l-rhamnopyranose, 3 - O-acetyl-4-O-feruloyl-l-rhamnopyranose, 2-O-acetyl-4-O-(O-methylferuloyl)-a-l-rhamnopyranose, 2-O-acetyl-4-O-(p-methoxy cinnamoyl)-a-l-rhamno pyranose and some known compounds like (4-O-(p-methoxycinnamoyl)- a - l - rhamnopyranose, p-methoxycinnamicacid, ferulicacid and O-methylferulic acid [30].

Non-Phenolic Compounds: The methanol extract of the leaves of *Buddleja asiatica* was found to contain non-phenolic compounds like 1-O-beta-D-glucopyranosyl-2-methoxy-3-(2-hydroxy-triaconta-3,12-dienoate)-glycerol, 3 – O - [alpha-L-rhamno pyranosyl-(1-->4)-beta-D-glucopyranosyl-(1-->3)]-[beta-D-glucopyranosyl-(1-->2)] – beta - D-fuco pyranosyl-olean-11,13(18)-diene-3 beta,23,28-triol, 3-O-[alpha-L-rhamnopyranosyl - (1-->4) - beta - glucopyranosyl-(1-->4)-beta-D-glucopyranosyl- (1->3)]-beta-D-fucopyranosyl-olean-11,13(18)-diene - 3, 23,28-triol and 3–O-[alpha-L-rhamno pyranosyl-(1-->4)-beta-D-glucopyranosyl-(1-->3)]-[beta - D-xylopyranosyl-(1->2)]-beta-D-glucurono pyranosyl -acid-olean-11,13(18)-diene-3 beta,23,28-triol. All the compounds were found to be potent antioxidant agents [31].

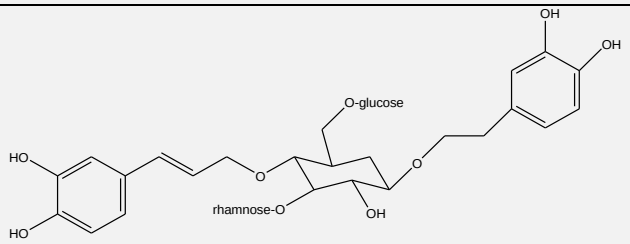
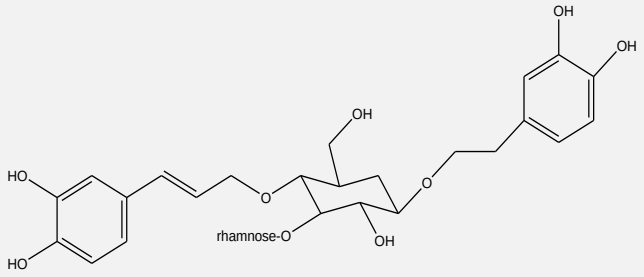
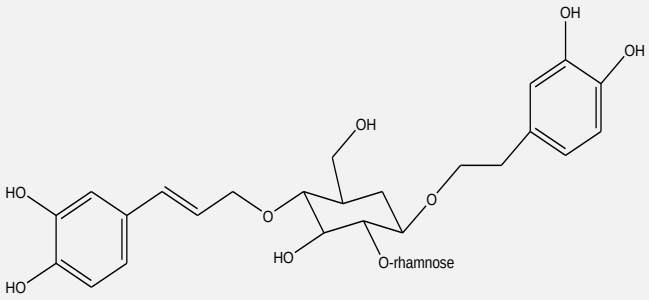
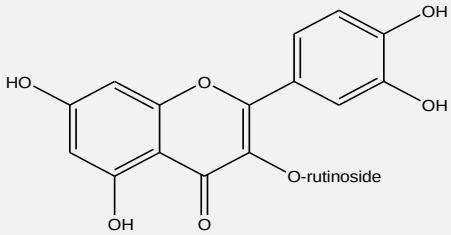
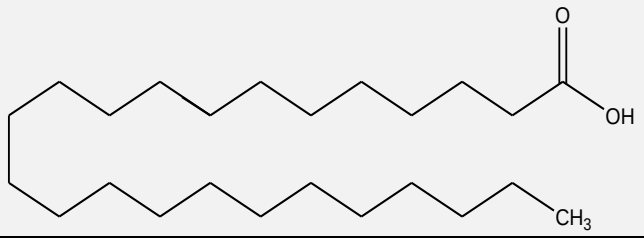
Flavonoids: Four flavonoids namely apigenin**,** acacetin-7-O-β-D-glucoside**,** apigenin-7-O-β-D-glucoside and linarin were isolated from ethylacetate fraction of the ethanolic extract of *Buddleia asiatica* flowers [32]. The isolated compounds were identified by comparing their physicochemical and spectral data. In another experiment done on leaves of methanolic extracts of *Buddleja asiatica*, some flavonoids like quercetin, kaempferol, rutin, ajugol and luteolin were isolated by column chromatography [33].

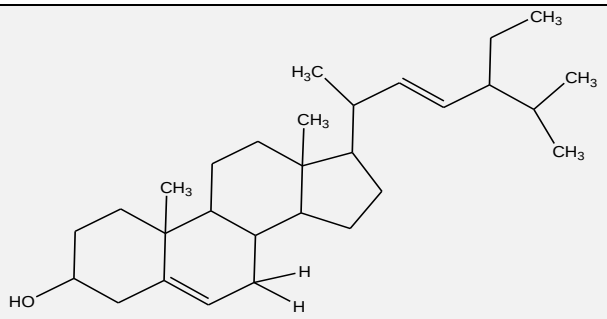
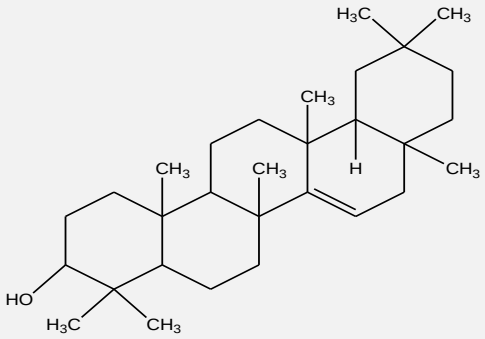
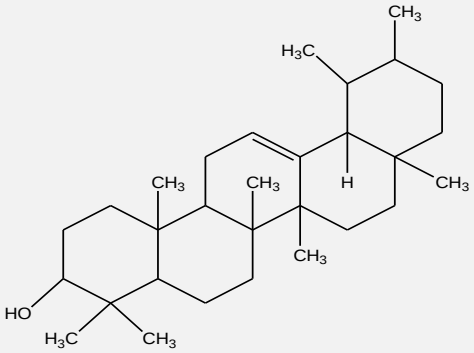
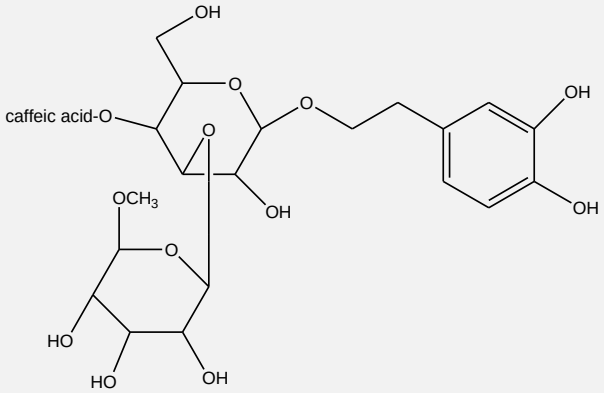
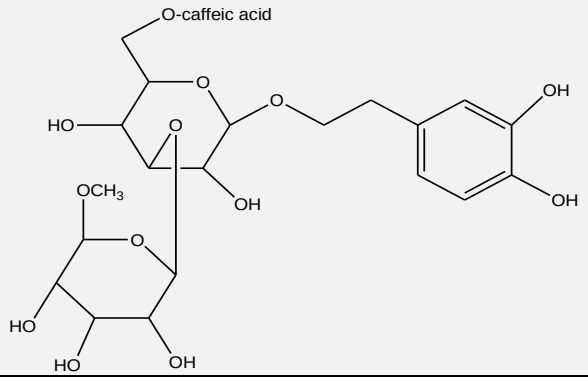
Triterpenoids:
Two new triterpenoids namely 13, 28-epoxy-23-hydroxy-11-oleanene-3-one and 13, 28- epoxy-21β, 23-dihydroxy-11-oleanene-3-one were isolated from the aerial parts of *Buddleja asiatica.* Known compounds like 13, 28-epoxy-3β, 23-O-isopropylidene-11-oleanene, 13, 28-epoxy-3β, 23-dihydroxy-11 oleanene, 3β, 23, 28-trihydroxy-11α-methoxy-12 oleanene, maslinicacid, β-amyrin, oleanolic aldehyde and oleanolic acid were also

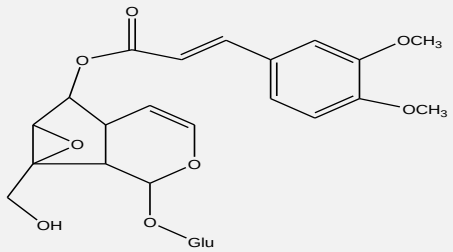
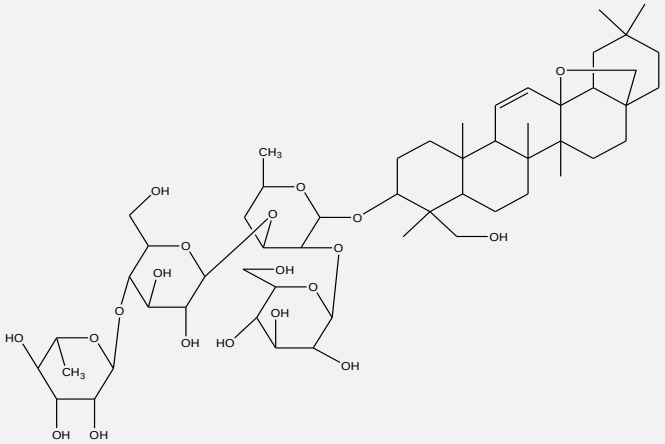
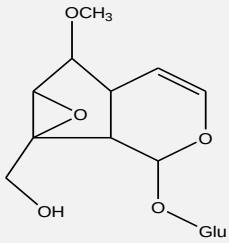
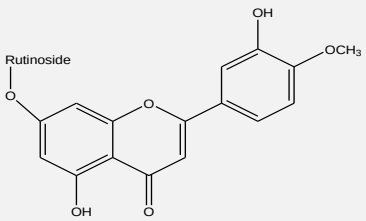
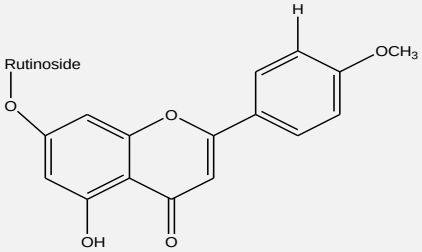
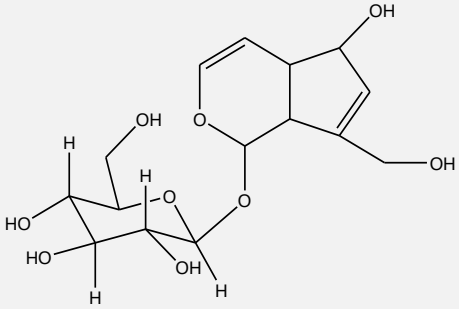
isolated from the methanol extract [34] of *Buddleja asiatica*.

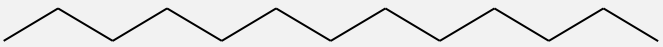
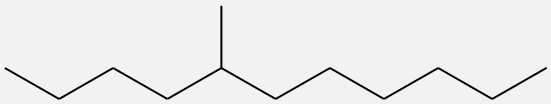
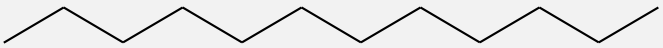
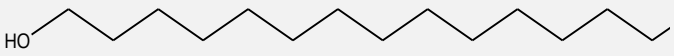
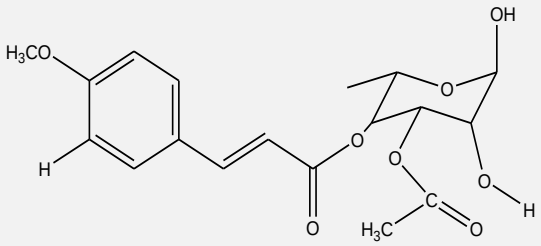
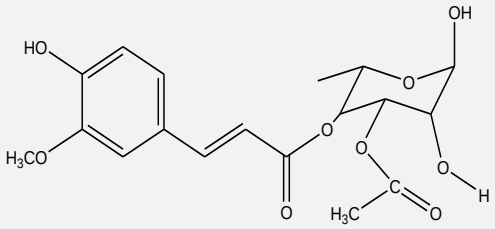
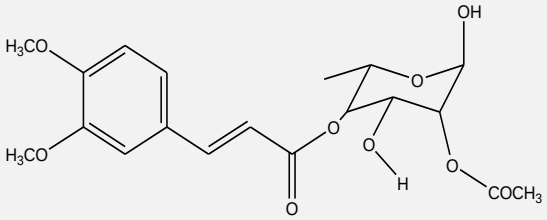
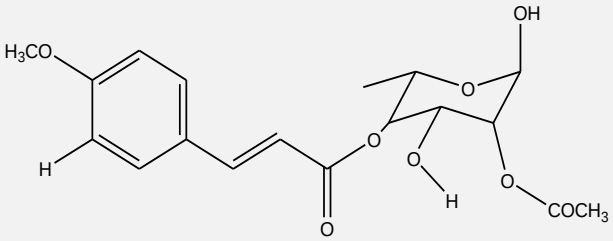
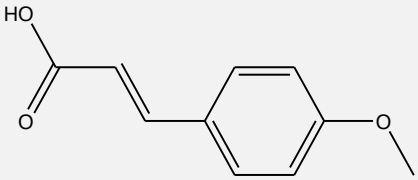
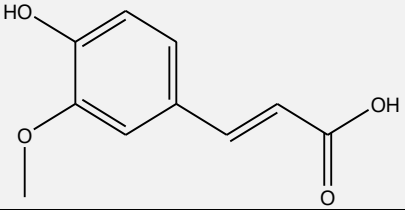
Miscellaneous compounds: A cyclopentanoid lactone called buddlin was isolated from the whole plant [35]. Two benzoates called 3,3-dimethylundecan-20-yl4-acetyl - 2,3,6-trimethoxy benzoate and 3,3-dimethylundecan-20- yl 4-acetyl-6-hydroxy-2,3-dimethoxybenzoate were isolated from ethylacetate soluble [36] fraction of *Buddleja asiatica*. Apart from this many phytoconstituents like fenchone, anethole, phytol, sulfolane, 4-oxo-ß-ionol, 5, 7-dimethoxy-2, 2-dimethyl-2H-chromene, and 4-isopropyl-5-methylphenol were identified from various extracts of *Buddleja asiatica* [37]. The structures of different active constituents present in the *Buddleja asiatica* are mentioned in **Table 4**.

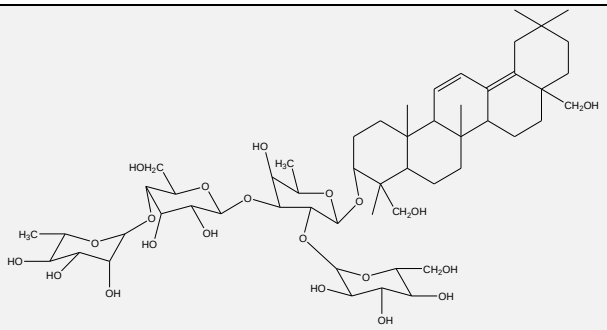
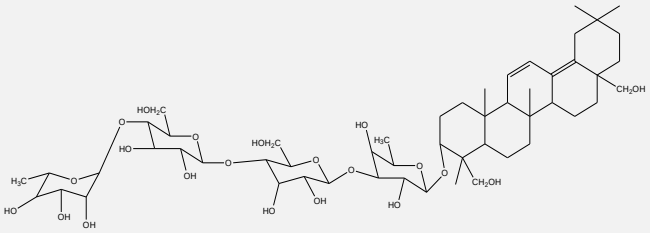
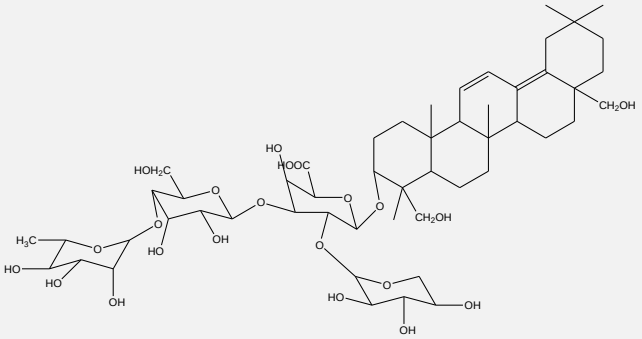
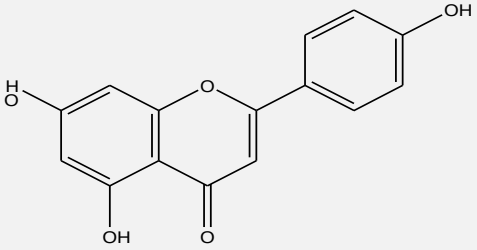
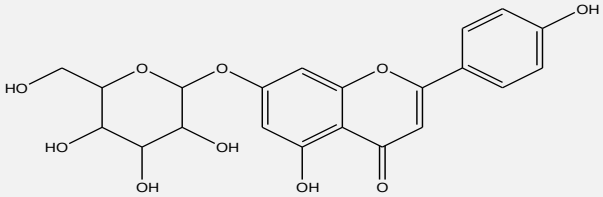
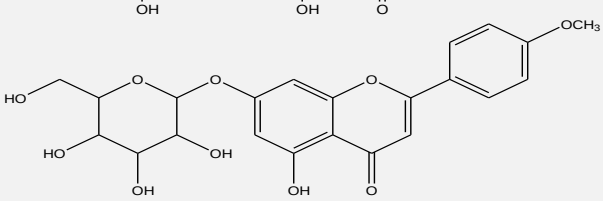
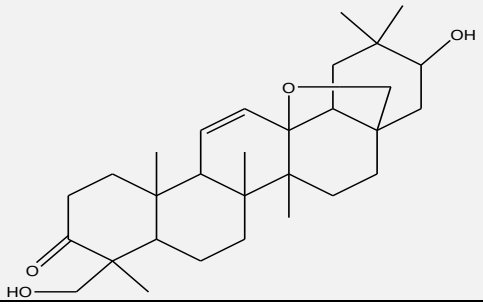
TABLE 4: CHEMICAL CONSTITUENTS IDENTIFIED, ISOLATED FROM *BUDDLEJA ASIATICA*

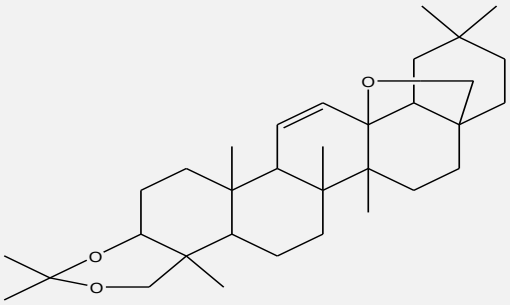
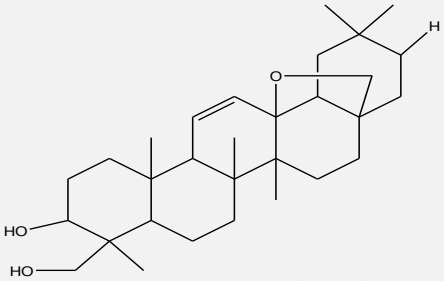
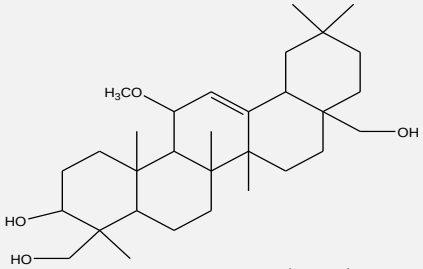
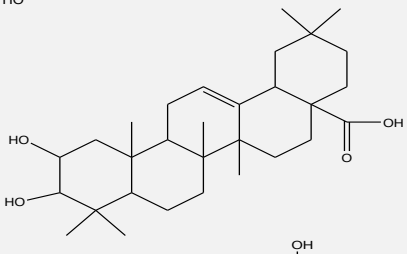
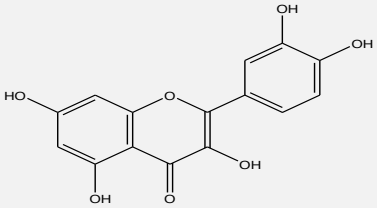
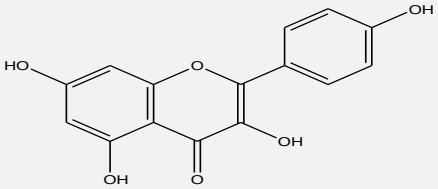
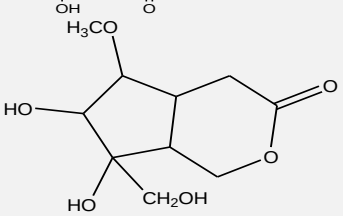
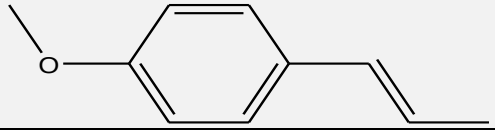
Phytoconstituent	Structure	Plant Parts	Ref.
3,4 dihydroxy phenylethyl alcohol 8-*O*[(4'-*O*-feruoyl)-α-Lrhamnopyranosyl-(1"→3') –β-D-glucopyranosyl-(1'"→6')]- β-D-glucopyranoside. (phenyl ethanoid glycoside)		Leaves	3
E-acteoside (phenyl ethanoid glycoside)		Leaves	3.
E-iso acteoside (phenyl ethanoid glycoside)		Leaves	3.
Rutin (flavonoid)		Leaves	3.
lignoceric acid (saturated fatty acid)		Whole plant	23

stigmasterol (sterol)		Leaves	23
Taraxerol (triterpenoid)		Whole plant	23
α-Amyrin (triterpenoid		Whole plant	23
Isoacteoside (phenyl propanoid ester)		Flowering parts	28
Acteoside (phenyl propanoid ester)		Flowering parts	28

6-*O*-(3’’,4’’-dimethoxycinnamoyl) catalpol (iridoid glucoside)		Flowering parts	28
Mimengoside A (triterpene saponin)		Flowering parts	28
Methyl catalpol (iridoid glucoside)		Flowering parts	28
Diosmin (flavonoid)		Flowering parts	28
Linarin (flavonoid)		Flowering parts	28
Aucubin (iridoid glycoside)		Leaves	28

n-Tridecane (alkane)		Leaves	29
5-Methyl undecane (alkane)		Leaves	29
n-Dodecane (alkane)		Leaves	29
n-Hexadecanol		Leaves	29
3-O-acetyl-4-O-(p-methoxycinnamoyl)-a-l-rhamnopyranose. (glycoside)		Aerial parts	30
3-O-acetyl-4-O-feruloyla-l-rhamnopyranose. (glycoside)		Aerial parts	30
2-O-acetyl-4-O-(O-methylferuloyl)-a-l-rhamnopyranose. (glycoside)		Aerial parts	30
2-O-acetyl-4-O-(p-methoxycinnamoyl)-a-l-rhamnopyranose. (glycoside)		Aerial parts	30
p-methoxy cinnamic acid (hydroxyl acid)		Leaves	30
Ferulic acid (phenolic acid)		Leaves	30

3-*O*-[α-l-rhamnopyranosyl-(154)--d-glucopyranosyl-(153)]-[-d-glucopyranosyl-(152)]--d-fucopyranosyl-olean-11,13(18)-diene-3,23,28-triol (terpenoid)		Leaves	31
3-*O*-[α-l-rhamnopyranosyl-(154)--d-glucopyranosyl-(154)--d-glucopyranosyl-(153)]--d-fucopyranosyl-olean-11,13(18)-diene-3,23,28-triol (terpenoid)		Leaves	31
3-*O*-[α-l-rhamnopyranosyl-(154)--d-glucopyranosyl-(153)]-[-d-xylopyranosyl-(152)]--d-glucuronopyranosyl-acid-olean-11,13(18)-diene-3,23,28-triol (terpenoid)		Leaves	31
Apigenin (flavonoid)		Flowers	32
Apigenin-7-O-β-D-glucoside (Flavonoid)		Flowers	32
Acacetin-7-O-β-D-glucoside (Flavonoid)		Flowers	32
13,28-epoxy-21β,23-dihydroxy-11-oleanene-3-one (triterpenoid)		Aerial parts	34

13,28-epoxy-3β,23-*O*-isopropylidene-11-oleanene (triterpenoid)		Aerial parts	34
13,28-epoxy-3β,23-dihydroxy-11-oleanene (triterpenoid)		Aerial parts	34
3β,23,28-trihydroxy-11α-methoxy-12-oleanene (triterpenoid)		Aerial parts	34
Maslinic acid (triterpene)		Aerial parts	34
Quercetin (Flavonoid)		Flowers	33
Kaempferol (flavonoid)		Leaves	33
Buddlin (lactone)		Whole plant	35
Anethole (essential oil)		Aerial parts	37

CONCLUSION: *Buddleja asiatica* is widely dispersed throughout India. Extensive literature survey revealed the traditional use of *Buddleja asiatica* in the treatment of various ailments. The plant exhibits many pharmacological activities like antioxidant, anti-inflammatory, antihepatotoxic, antipyretic, hypotensive and antimalarial properties. *Buddleja asiatica* is enriched with phytoconstituents like alkaloids, phenyl propanoid, flavonol, carotenoid, steroid, lipid and terpenes. Toxicity studies on *Buddleja asiatica* concluded that the extracts were quite safe and had no toxic effects on cell lines. Since *Buddleja asiatica* holds a high medicinal value, further studies on this plant should be considered in phytochemical standardization and clinical studies. A systematic phytochemical work is under progress in author's laboratory.

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CONFLICT OF INTEREST: No

REFERENCES:

1. Chopra RN, Nayar SL, Chopra IC. Glossary of Indian medicinal plants. Council of Scientific & Industrial Research. New Delhi: 1956 pg: 42.
2. Waranusantigul P, Kruatrachue M, Pokethitiyook P and Auesukaree C. Evaluation of Pb Phytoremediation Potential in *Buddleja asiatica* and *Buddleja paniculata*. Water Air Soil Pollution 2008; 193:79–90.
3. Mohamed M, Abdou A, Saad A and Ibrahim M: Cytotoxic activity of *Buddleja asiatica*. Life Science Journal 2013; 10 (1):2773-2777.
4. Wagner WL, Herbst DR and Sohmer SH: Manual of the Flowering Plants of Hawai'I, USA: University of Hawai'i Press, 1999.
5. Groves RH, Hosking JR, Batianoff GN, Cooke DA, Cowie ID, Johnson RW and Moerkerk M: Weed categories for natural and agricultural ecosystem management. Canberra, Australia: Bureau of Rural Sciences 2003; 115-117.
6. Houghton PJ: Ethnopharmacology of some *Buddleja* species. Journal of Ethnopharmacology 1984; 11:293-308.
7. Wester L: Origin and distribution of adventives alien flowering plants in Hawai'i. In: Alien plant invasions in native ecosystems of Hawaii: Management and research Honolulu, Hawaii, USA: University of Hawaii Cooperative National Park Resources Studies Unit, 99-154, 1992.
8. Huxley A: The New Royal Horticultural Society dictionary of gardening. Maxmillan press.1992.
9. Kay MK, Gresham B, Hill RL and Zhang X: The disintegration of the Scrophulariaceae and the biological control of *Buddleja davidii*. In: Proceedings of the XII International Symposium on Biological Control of Weeds .Wallingford, UK: CAB International, 2008:287-291.
10. Bird R: Growing from Seed. Volume 3, Thompson and Morgan, 1990.
11. Sheat W G: Propagation of Trees, Shrubs and Conifers. St. Martin publications, 1948.
12. Maheshwari JK: The Flora of Delhi. Council of Scientific and Industrial Research, New Delhi, India, 1963.pg:222.
13. Li PT and Leeuwenberg AJM: Loganiaceae. In: Flora of China, Beijing, China: Science Press, 1996.
14. Arjun J, Verma A K and Prasad S B: Method of preparation and biochemical analysis of local tribal wine Judima: an indegenous alcohol used by Dimasa tribe of North Cachhar Hills District of Assam, India. International Food Research Journal 2014; 21(2): 463-470.
15. Sawian JT, Jeeva S, Lyndem, FG, Mishra BP and Laloo RC: Wild edible plants of Meghalaya, North-east India. Natural Product Radiance 2007; 6(5): 410-426.
16. Guerrero LA: Medicinal uses of philipine plants. Philippines Bureau of Forestry Bull 1921; 22: 149-246.
17. Shah GM, Khan MA, Ahmad M, Zafar M and khan AA: Observations on antifertility and abortifacient herbal drugs. African Journal of Biotechnology 2009; 8 (9): 1959-1964.
18. Jiangsu New Medical College: A dictionary of Chinese traditional medicine. Shanghai Science and Technology Press,Shanghai, 1977
19. Hartwell J: Plants used against cancer. Lloydia 1970; 33:87–94.
20. Thapa B, Walker DH and Sinclair FL: Indigenous knowledge of the feeding value of tree fodder. Animal Feed Science and Technology 1997; 68(1/2):37-54.
21. Ali F, Ali I, Khan H, Khan and Gilani AH: Studies on *Buddleja asiatica* antibacterial, antifungal, antispasmodic and Ca++ antagonist activities. African Journal of Biotechnology 2011; 10(39): 7679-7683.
22. Ali F, Jan AK, Khan NM, Ali N and Khan S: GC/MS Analysis, antimicrobial and in vitro anti-cholinesterase activities of the essential oil from *Buddleja asiatica*. Bangladesh Journal of Pharmacology 2015; 10(4):891-95.
23. Khan FA, Khan NM , Khan HU , Khan S, Ahmad and Maitland DJ: Buddlejol, a new a-chymotrypsin inhibitor from *Buddleja asiatica*. Medicinal chemistry research 2015; 24(3):980–986.
24. Venkatachalam MR and Jebanesan A: Screening of repellent activity of certain plants of Tamil Nadu, India. Convergence 2001; 3(1): 39–43.
25. Singh S, Mathur A, Sinha J, Singh N and Kohli R: A Study on the Mechanism of the Hypotensive Activity of *Buddleja asiatica* (Newarpati). Pharmaceutical Biology 1980; 18(2): 83-87
26. Liao YH, Houghton PJ and Hoult JR: Novel and known constituents from *Buddleja* species and their activity against leukocyte eicosanoid generation. Journal of Natural Products. 1999; 62(9):1241-1245.
27. John and Ravindarraj: Antioxidant activity of *Buddleja asiatica.* Indian Journal of Applied Research 2015; 5 (1):49-51.
28. El-Domiaty MM, Wink M, Abdel Aal MM, Abou-Hashem MM and Abd-Alla RH: Antihepatotoxic Activity and Chemical Constituents of *Buddleja asiatica Lour*. Z. Naturforsch 2009; 64 c, 11 – 19.
29. Joshi S, Mishra D, Bisht G and Khetwal KS: Comparative study of essential oil composition of *Buddleja asiatica* and *Buddleja davidii* aerial parts. International Journal of Green Pharmacy 2012; 6:23-5.

30. Liu YP, Caia XH, Lia WQ, and Luo XD: Phenylpropanoid Esters of Rhamnose from *Buddleja asiatica.* Helvetica Chimica Acta 2008; 91(7) 1299-1304.
31. El-Sayed MM, Abdel-Hameed el-SS, Ahmed WS and el-Wakil EA: Non -phenolic antioxidant compounds from *Buddleja asiatica*. Z Naturforsch C 2008; 63(7-8):483-91.
32. Fathy MM, Al-sofany RH, Kassem HA and Kandil ZA: Phytochemical And Biological Studies of Some Phenolic from *Buddleia Asiatica* Lour. and *Buddleia Madagascariensis Lam*. Growing In Egypt. Bulletin of Faculty of Pharmacy 2006; 44: 207-37.
33. Bate-Smith EC: The phenolic constituents of plants and their taxonomic significance. I. Dicotyledons. Botanical Journal of the Linnean Society 1962; 58(371): 95-173.
34. Liu YP, Caia XH, Lia WQ, and Luo XD: Two New Oleanane-type Triterpenoids from *Buddleja asiatica.* Z. Naturforsch 2008; 63b: 915 – 919.
35. Chen H, Xu C, Liu DQ, An SQ and Tan RX: Buddlin, a new compound from *Buddleja asiatica*. Fitoterapia 2005; 76 (6) 588–589
36. Ali F, Khan HU, Afzal M, Samad A, Khan SU and Ali I: Two new cholinesterase inhibitors asiatoates A and B from *Buddleja asiatica*. Journal of Asian Natural Products Research 2013; 15 (6), 631-637
37. Dawidar AM, Omar M Khalaf, Soha MM. Abdel majeed, and Mamdouh Abdel-Mogib: Phytochemical and Biological Evaluation of *Buddleja asiatica.* Research Journal of Pharmaceutical, Biological and Chemical Sciences 2015; 6 (5):680-692.

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