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Taruba Ansari
Central Ayurveda Research Institute, Jhansi, Uttar Pradesh, India

Mohd Saleem
Aligarh Muslim University, Aligarh, Uttar Pradesh, India

Mohd Asif
Regional Ayurveda Research Institute, Ranikhet, Uttarakhand, India

Shyam Baboo Prasad
Regional Ayurveda Research Institute, Pune, Maharashtra, India

Vijay Kumar
Central Ayurveda Research Institute, Jhansi, Uttar Pradesh, India

Rampratap Meena
Central Council for Research in Unani Medicine, New Delhi, India

Corresponding Author:
Taruba Ansari
Central Ayurveda Research Institute, Jhansi, Uttar Pradesh, India

Morphological, phytochemical and ethnopharmacological attributes of *Xylosma longifolia* Clos: A review

Taruba Ansari, Mohd Saleem, Mohd Asif, Shyam Baboo Prasad, Vijay Kumar and Rampratap Meena

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Abstract
Xylosma longifolia Clos. (Salicaceae), a medium-sized tree is found mainly in India and China. It is known by different names such as Kattari, Kata-koli, Mota-koli, Kataponial, Nongleishang and Dieng-kani in different parts of India. It is widely spread in northeast India and also in most parts of China. In India, tribal communities such as ''Miri'' of Assam, ''Kom'' and "Tangkhul" of Manipur, "Lois'' of Imphal, use it to treat cough, spasms, dysentery, insomnia, restlessness, pustules and jaundice. This plant is also enormously used in Ayurveda, Chinese and Vietnamese traditional medicinal systems. The principle compounds reported are xylongoside A, xylongoside B and xylosmaloside. The presence of secondary metabolites imparts its bioactivities including antimicrobial, analgesic, anti-dermatophytic, anti-tubercular, antioxidant and insecticidal activities. To date, not even a single review has been published on *X. longifolia*. Due to the broad continued interest in the efficacy of *X. longifolia* and extensive practice in traditional medicines, this review intends to recapitulate detailed and up-to-date information on this plant. The current review assessed and summarized the knowledge on geographic distribution, morphological features, ethnobotany, phytochemistry and pharmacological activities of *X. longifolia*.

Keywords: *Xylosma longifolia*, Kattari, xylongoside, anti-tubercular, ethnobotany

Introduction
Plants are a rich source of chemical compounds. Many of these active chemical compounds are known to possess medicinal properties. These medicinal properties of plants are beneficial in treating and preventing numerous diseases. The traditional and even modern medicinal systems rely upon plants for primary health care needs. Traditional medicines are still the backbone of health care in many poor and developing nations. In this medicinal system, the majority of treatments and cures are derived from natural resources like plants. In developed countries, plants with medicinal properties are utilized to manufacture essential drugs al [1, 2]. One-fourth of these modern drugs are derived from plants [3]. The major traditional medicinal systems practiced worldwide are Ayurveda, Unani, Siddha and Chinese. The main constituents of these medicinal systems are either plants or plant-based products.
It is reported that worldwide about 35,000 to 70,000 plant species are having medicinal properties [4, 5], including 7500 plant species in India [6]. The plant families *viz*., Acanthaceae, Apiaceae, Asteraceae, Euphorbiaceae, Fabaceae, Lamiaceae, Poaceae, Rosaceae and Rubiaceae account for the majority of medicinal plant species [7]. Medicinal properties derived from plants can come from many different parts of a plant, including leaves, roots, bark, fruit, seeds, flowers and others.
Xylosma longifolia Clos., commonly known as 'Long leaved xylosma' is a member of the family Salicaceae and a native of India and China. This species has been used as traditional medicine in several countries, including China, India, Pakistan and Vietnam [8-11]. The tribal communities of north India use it extensively to cure various ailments and diseases [12, 13]. Despite immense use in folk medicines, the significance of *X. longifolia* appears to be overshadowed by other important medicinal plants. There is a dearth of published information on *X. longifolia*, so our aim in this review is to discuss its distribution, morphology, ethnobotany, phytochemistry and biological activities.

Literature survey
In this review article, all the data available till now was collected and pooled. The available information on *X. longifolia* was gathered via online electronic databases and search engines.

The databases were Google Scholar, Science Direct, PubMed, NCBI, Web of Science, SciFinder scholar, Wiley Online Library and Springer Link. Internationally, nationally and locally published journals, books, book chapters, magazines, conference proceedings, theses and dissertations were also consulted. The keywords used in the search were ''medicinal plants'', ''*X. longifolia*'', ''phytochemistry of *X. longifolia*'', ''ethnobotanical uses of *X. longifolia*'', ''pharmacological properties''. Articles in languages other than English were not included. For the most authentic classification, World Flora Online was considered [14]. The accepted botanical name and synonyms were taken from World Flora Online and e Flora of India [14, 15]. The chemical structures were drawn using ChemDraw Ultra 15.0 software.

Taxonomy

This classification was taken from World Flora Online consortium [14]

Kingdom: Plantae
Phylum: Tracheophyta
Class: Magnoliopsida
Order: Malpighiales
Family: Salicaceae
Tribe: Flacourtieae
Genus: *Xylosma*
Species: *longifolia*

Xylosma longifolia Clos is the accepted name [14]; synonyms are *Flacourtia ferox* Wall. ex Voigt, *Myladenia serrata* H. K. Airy Shaw, *Myroxylon longifolium* (Clos) Kuntze, *Xylosma congesta* var. *kwangtungensis* (F.P. Metcalf) Rehder and *Xylosma fasciculiflorum* S.S. Lai (e Flora of India). In India, it is commonly known as Dandal, Katari, Kandhar, Katpatra, Sialu, Pansra, Phalama, Chirindi, Chirandi and Draindu [15].

Geographical distribution

The genus is predominantly native to tropic and subtropic regions of the world. This plant is widely distributed in China, India, Thailand, Vietnam, Myanmar, Nepal, Pakistan and Laos [16]. It is distributed in Guizhou, Yunnan, Fujian, Guangxi, Guangdong and Hainan provinces of China [17]. In India, it is found in Kashmir, Himachal Pradesh, Uttar Pradesh, Punjab, Haryana, West Bengal, Bihar, Orissa, Andhra Pradesh, Tamil Nadu, Assam, Manipur, Tripura, Meghalaya and Arunachal Pradesh [18, 19].

Botanical description

It is a tall shrub or medium sized tree reaching a height of 4 to 7 metres. Bark is scented and gray-brown in colour. Generally, trunk is armed with simple and branched spines but sometimes spines are altogether absent. Branchlets are shiny, covered with axillary spines and show sympodial growth.

Leaves are simple and alternate having large lamina and short petiole without stipule. The length of petiole is 5 to 8 mm while lamina is 4 to 15 cm long and 2.5 to 5.0 cm wide. Leaf lamina is smooth and leathery in touch. It shows variations in its shape; it may be narrowly elliptic, oblong-elliptic, oblong-lance shaped or narrowly obovate. The lamina has acute, cuneate and very rarely obtuse base and acute to shortly acuminate apex while margins are serrate. Lateral veins are branched, prominent, 6 to 11 in number and raised on both surfaces.

Flowers are unisexual, hypogynous, bracteate, greenish, measuring 2.5 to 3.5 mm in diameter. They are borne in short branched clustered racemes, present singly or clustered in the axil of leaf. Pedicel is short measures 1 to 2 mm, slender and pubescent. Bracts are ovate in staminate flowers while lanceolate in pistillate flowers. Sepals are 4 to 5 in number, persistent, ovate or lance-shaped, measures 1-2 mm in length, glabrous or sparsely puberulous with spreading hairs. The margin of sepal is entire to erose and glabrous. Petals are absent in both male and female flowers. In staminate flower, stamens are surrounded by small and connate glandular disk; anthers are minute (0.3 mm), ellipsoidal and dorsifixed. Pistillate flower has annular or few lobed disk; ovoid superior ovary having 2 or 3 placentas, each with 2 or 3 ovule. Styles are persistent, very short measuring 0.5-0.8 mm or even less, 2 or 3 in number and partly or completely joined.

Fruit is a globose, dry berry completely enclosed in a thin sheath and measuring 4-6 mm in diameter. These berries are red when fully ripe, later turns black on drying. Seeds are 4 or 5 in number, brown, measuring 4 mm, oblong to obovoid in shape, flattened on one or more sides by mutual compression [17].

Phenology and agronomic aspects

X. longifolia is an evergreen plant that occurs in moist subtropical forests and ravines at 600 to 1500m above sea level. Pollination is mainly entomophilous but cleistogamy or allogamy can also be seen. The plant flowers in the month of January-February while fruiting occurs during June-July. Seed dispersal takes place either by autochory, zoochory or anthropochory [20].

Ethnomedicinal/Traditional uses

X. longifolia is a well-known plant and is utilized in numerous ways by local people worldwide. It is known by different names in the different parts of the world. In Rawalpindi (Pakistan), it is commonly known as Batti. The straight and long branches are used as support for various purposes and used for fuel [10]. It is planted in Hong Kong (China) to restore degraded hillsides [8]. *X. longifolia* is an important ethnomedicinal plant used in the Northern region of India. In Assam and Manipur, this plant is highly prescribed for several disorders in the indigenous medicinal system. Locally in Assam, *X. longifolia* is called by names 'Mota-koli' and 'Kataponial'. Different tribes of Assam use it for different purposes. The tribal community called Miri uses young leaves of *X. longifolia* to make beer [21]. The tea tribes orally take the leaf extract or juice to cure jaundice [22]. It is used to treat spasms, dysentery, restlessness and insomnia [23]. In Manipur, it is known as Nongleishang by native population. It is widely used in folk medicines. The plant is used for a wide range of common disease such as dysentery, dizziness, hoarseness and regulation of blood circulation [12]. The Kom community is depended upon *X. longifolia* for curing the diseases and ailments of their domesticated animals. They use leaves of this plant to kill ticks and lice [24]. The extract obtained after boiling leaves in water is used in treating kidney stone [25]. The stem bark and fresh leaf extracts are used in treating ringworm, scabies and acne [26]. The Tangkhul tribe of Ukhrul district uses its fresh leaves extract to treat muscular sprain [27]. People in Manipur boil leaves of *X. longifolia* in water and take stem bath to treat pustules [28]. The Maring tribe boils the leaves of this plant and takes 3-4 spoons twice a day till piles is cured [29]. The Lois community of Andro Village in Imphal East District use decoction of leaves of *X. longifolia* alone or mix them with *Azadirachta indica* leaves to treats piles [30]. The leaves are also used for cough and liver disorder

[31]. *X. longifolia* is commonly known as Khand-gair, Sialu or Katrai in Uttarakhand and is bark used to relieve stomach pain [13]. *X. longifolia* served as host for an algal pathogen, *Cephaleuros* in Mysore [32]. The leaf and bark of the plant is used as fuel in the Himalayan region [33]. The paste leaf and bark is externally used for skin diseases [34].

Apart from use in folk medicines, *X. longifolia* is also extensively used in different traditional medicinal systems. The leaf and stem bark of the plant have therapeutic activities and extensively used for several medicinal system. The steamed stems are used to treat pain and protruding hemorrhoids. The roots are used as tonics and nectar is used for fever and cough. Fresh leaves and stem bark extracts are used for ringworm, acne and scabies. The boiled and brewed leaves of this plant are used for curing fever, tuberculosis, inflammation and bronchial disorder [35]. In Ayurveda system of medicine, it is used as an active herb for treatment of insomnia due to its sedative and central nervous system stimulant properties [36]. In Vietnamese traditional medicine, it is used for liver disease and physical injuries [11]. In India, *X. longifolia* is grown for its edible fruits [9]. The plant is used in traditional Chinese medicines in treating amenorrhea and used as ecbolic [37].

Phytochemistry

Several studies reported the presence of active chemical constituents such as glycosides, triterpenoids, flavonoids, sterols, fatty acid and others in different parts of *X. longifolia* [35, 16, 38-40]. However, glycoside, triterpenoids, flavonoids, fatty acids and sterols were the main classes of secondary metabolites [16, 35, 39, 41]. The glycosides namely, xylosmaloside was isolated from whole plant [35] whereas xylongoside A and xylongoside B from stem bark of *X. longifolia* [39]. Flavonoids like rutin and kaempferol-3-rutinoside were identified in whole plant [40]. On the other hand, stem bark also contains triterpenoids such as friedelin and epifriedelanol [39, 42]. Apart from these compounds, other compounds like methyl caffeate, ethyl β-$_D$-glucopyranoside and roseoside were extracted from whole plant [35] whereas benzoic acid; β-orcinolcarboxylate; 2-(6-benzoyl-β-glucopyranosyloxy)-7-(1α,2α,6α-trihydroxy-5-oxocyclohex-3-enoyl)-5-hydroxybenzyl alcohol, atraric acid, methyl orsellinate, 8-hydroxy-6-methoxy-pentylisocoumarin and xylosmacin from stem bark [39, 42]. Unlike stem bark, previous phytochemical studies revealed that leaves of *X. longifolia* are the reservoir of secondary metabolites. The leaves contain flavonoids *viz*., kaempferol, kaempferol-3-rhamnoside, kaempferol-3-β-xylopyranoside-4'-α-rhamnoside, quercetin, quercetin-3-rhamnoside rutin and catechin [41]. Other studies showed the presence of triterpenoids (β-amyrin and friedelin) [38, 41], sterols (β-sitosterol and phytol) and fatty acids (n-hexadecanoic acid, cis-13,16-docasadienoic acid, 17-octadecynoic acid, 9,12-octadecadienoic acid (Z,Z)-) in leaves [16, 42, 43]. Besides these, olean-12-en-3α-ol-28-oic acid 3α-D-glucopyranoside, n-heneitriacontane [38], N,N-dimethylglycine, trichloroacetic acid, tridec-2-ynyl ester, L-(+)- ascorbic acid 2,6-dihexadecanoate, 3-heptadecen-5-yne, (Z)-, 3,7,11,15-tetramethyl-2-hexadecen-1-ol, cyclododecanol and sucrose were also detected in *X. longifolia* leaves [16].

Devi *et al*. evaluated the total phenolic and flavonoid contents of bark and leaves extracts of *X. longifolia* [40]. The total phenolic contents of the extracts from both leaf and bark occurred in the range of 12±1.27 to 56.6±4.84 mg gallic acid equivalent (GAE)/100g and 16±1.2 to 58±2.25 mg GAE/100g, respectively. Similarly, content of three major flavonoids *viz*., rutin, catechin and kaempferol were also quantified in the leaves and bark. The bark extracts contained more rutin and catechin contents than leaf extracts. However, kaempferol was present in trace or is completely absent. Highest rutin content was observed in petroleum ether (0.51%) followed by chloroform (0.22%) and least was found in methanol extracts of leaves (0.12%). In bark, the rutin contents noted were 0.67%, 0.65% and 0.56% in petroleum ether, chloroform and methanolic extracts, respectively. The catechin content in leaf was more in petroleum ether (1.88%) than in methanol (1.72%) and chloroform (1.56%) extracts. In bark, catechin contents were 4.29%, 1.73% and 1.24% in petroleum ether, chloroform and methanol extracts, respectively. In another study conducted by Devi *et al*., the total phenol, flavonoid and tannin contents of methanolic extract of leaves observed were 57.38±2.563 mg GAE/g, 36.70±0.676 mg quercetin equivalents (QE)/g and 31.08±1.300 mg tannic acid (TA)/ g, respectively [44]. Similarly, Bhattacharyya *et al*. conducted the preliminary phytochemical analysis of the methanolic extract of leaves of *X. longifolia* and calculated the alkaloid, flavonoid and phenolic content [16]. The total alkaloid, phenol and flavonoid contents were found to be 44.2±0.8 mg atropine equivalents/g, 42.9±2.43 mg catechol equivalent/g and 32.8±0.2 mg QE/g, respectively.

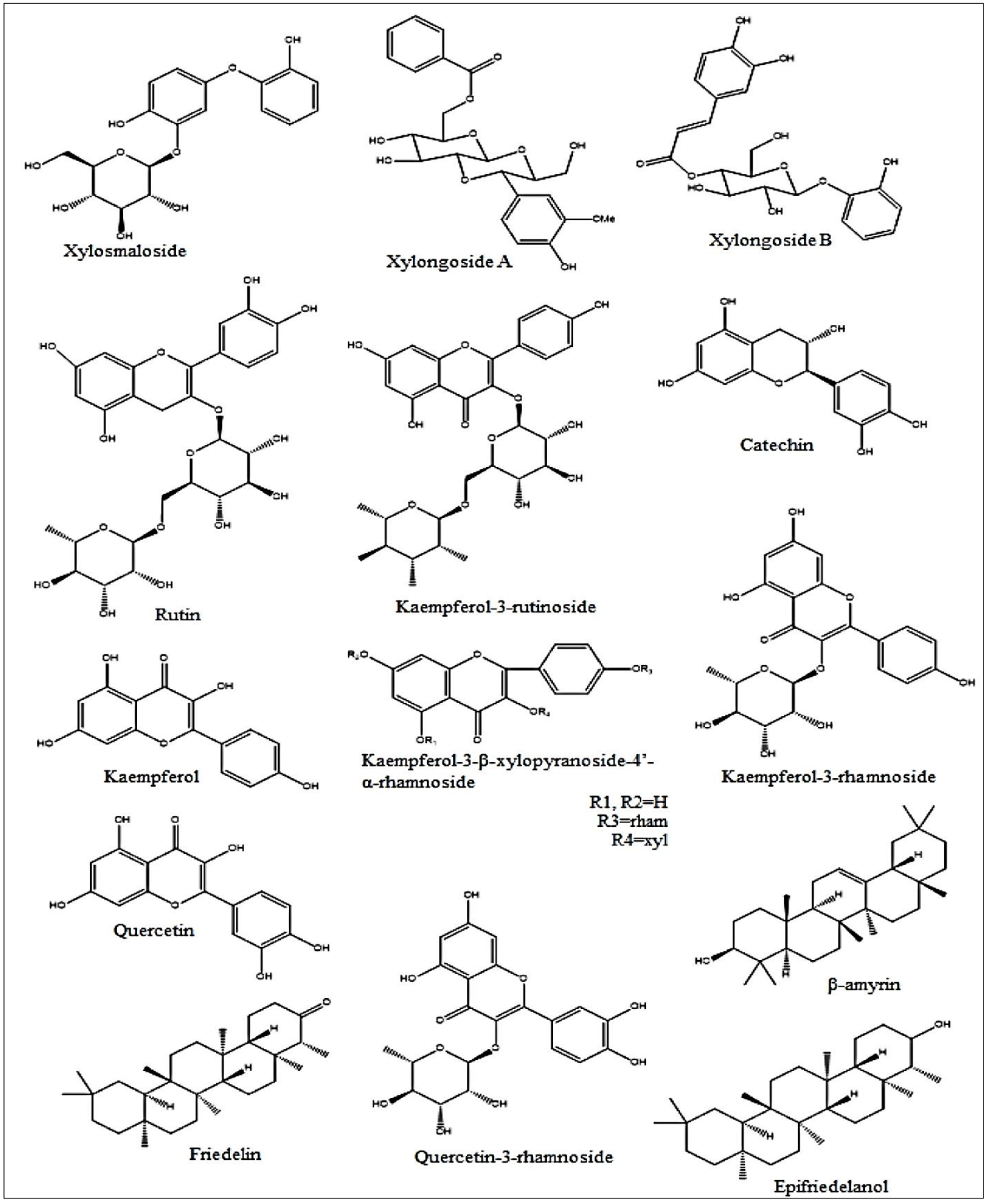
The previously published phytochemical data was confirmed by using analytical techniques such as chromatography, Mass Spectrometry (MS) and Nuclear Magnetic Resonance (NMR). These techniques provided aid in identifying and characterizing the chemical components present in *X. longifolia*. Ghalib extracted β-amyrin, friedelin, β-sitosterol, olean-12-en-3α-ol-28-oic acid 3α-D-glucopyranoside and n-heneitriacontane from leaves of *X. longifolia* [38]. The light petroleum ether-benzene (9:1) fraction of leaves yielded n-heneitriacontane and β-sitosterol using thin layer chromatography (TLC) and structures were characterized by ^{1}H NMR, MS and IR. The two triterpenoids *viz*., β-amyrin and friedelin were isolated from fraction of light petroleum ether-benzene (8:2-1:1) using TLC while structural characterization was done by IR, ^{1}H NMR and MS. On the other hand, the fraction obtained from benzene-ethyl acetate (9:1-8:2) solvent system gave olean-12-en-3α-ol-28-oic acid 3α-D-glucopyranoside and structure was elucidated by IR, UV, ^{1}H NMR, ^{13}C NMR and MS. Sultana *et al*. also obtained n-hentriacontane and β-sitosterol from leaves but using methanolic extract [43]. The petroleum ether-chloroform fraction in ratio 1:1 yielded n-hentriacontane whereas 1:3 gave β-sitosterol. The structural characterization of these compounds was done by ^{1}H NMR, ^{13}C NMR and MS.

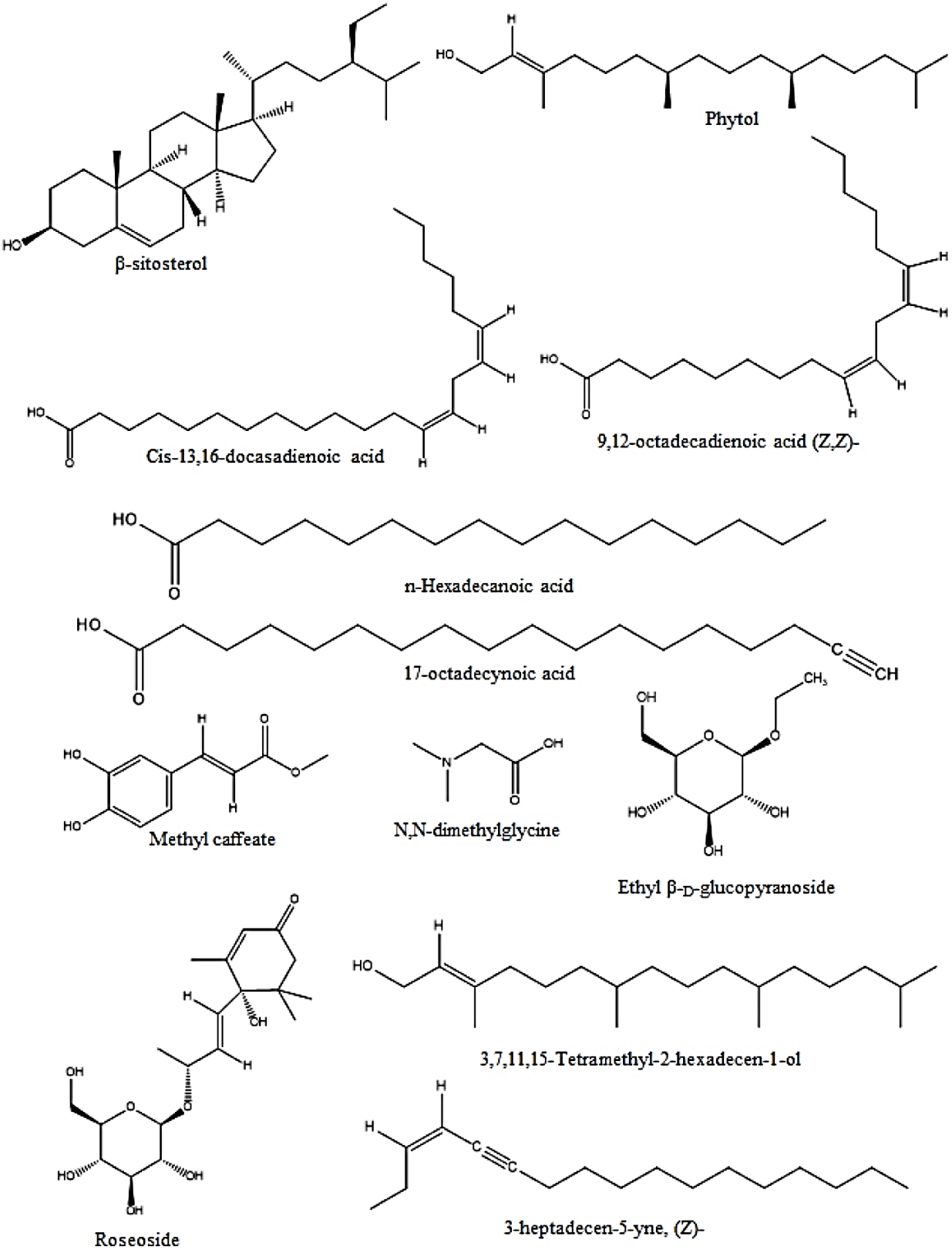
Ngan *et al*. identified 2-(6-benzoyl-β-glucopyranosyloxy)-7-(1α,2α,6α-trihydroxy-5-oxocyclohex-3-enoyl)-5-hydroxybenzyl alcohol, xylosmacin, methyl β-orcinolcarboxylate, β- orcinolcarboxylate, friedelin, epi-friedelanol, β- sitosterol and benzoic acid from bark using methanol [42]. The structures of these compounds were elucidated by mass spectroscopy and 2D NMR. The two glycosides namely, xylongoside A and xylongoside B were isolated by Truong *et al*. from methanol. The dichloromethane-methanol fraction yielded these compounds and characterization was done by mass spectrometry and 2D NMR [39].

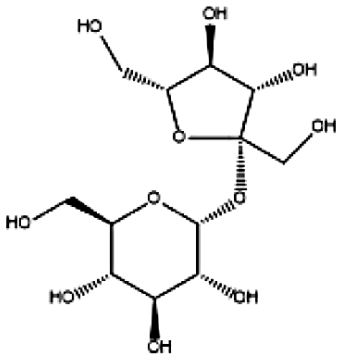
Parveen and Ghalib identified several flavonoids from methanolic extract of the leaves of *X. longifolia* [41]. The fractions obtained from ethyl acetate-methanol (9:1) solvent system yielded kaempferol and quercetin using column

chromatography and characterized using IR, ^{1}H NMR, UV and mass spectral data. Kaempferol-3-rhamnoside and quercetin-3-rhamnoside were obtained from ethyl acetate-methanol (7:3) fraction and their structures were confirmed by IR, UV, 'H NMR and MS. The ethylacetate-methanol (4:6-1:1) fractions yielded kaempferol-3-β-xylopyranoside-4'-α-rhamnoside and structural characterization was validated using IR, UV, 'H NMR and MS. Xylosmaloside, a diphenyl ether glycoside was isolated by Swapana *et al*. from methanolic extract of whole plant of *X. longifolia* using column chromatography and the structure was elucidated using MS, 2D-homo and heteronuclear NMR data [35].

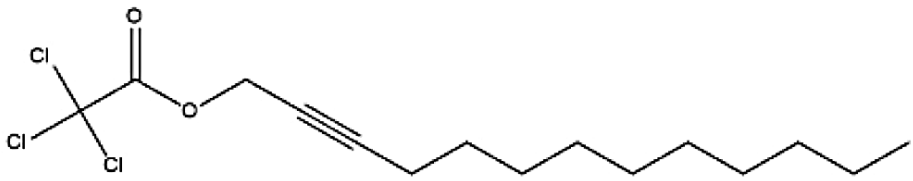
Bhattacharyya *et al*. identified and analyzed numerous chemical constituents namely, L-(+)-ascorbic acid 2, 6-dihexa-decanoate, N, N-dimethylglycine, 17-octadecynoic acid, n-Hexadecanoic acid, 3,7,11,15-tetramethyl-2-hexadecen-1-ol, phytol, sucrose, 9, 12-octadecadienoic acid (Z,Z)-, 3-heptadecen-5-yne, (Z)-, trichloroacetic acid, tridec-2-ynyl ester, cis-13,16-docadienoic acid and cyclododecanol from 95% methanolic extract of leaves using GC-MS [16]. Table 1 enlists the different phytoconstituents that have been reported from *X. longifolia* and their corresponding structures have been shown in Figure 1.



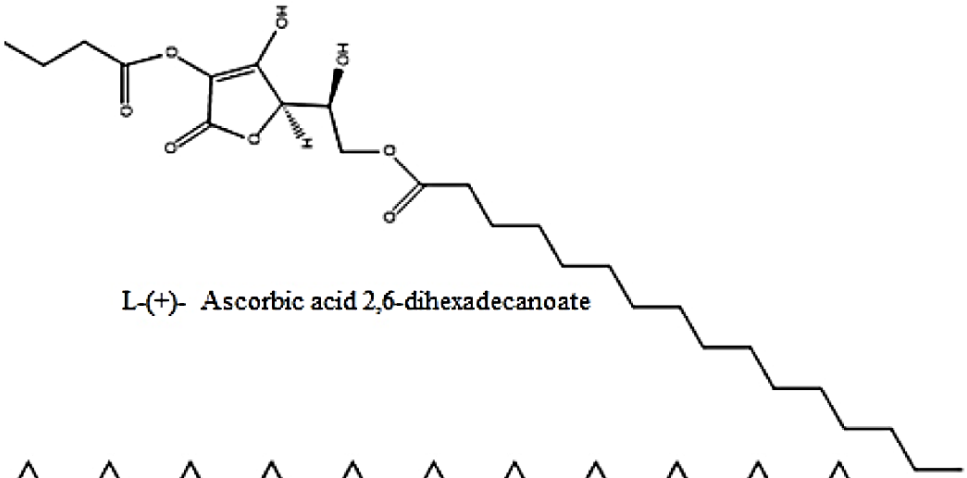

β-sitosterol
Phytol
Cis-13,16-docasadienoic acid
9,12-octadecadienoic acid (Z,Z)-
n-Hexadecanoic acid
17-octadecynoic acid
Methyl caffeate
N,N-dimethylglycine
Ethyl β-D-glucopyranoside
3,7,11,15-Tetramethyl-2-hexadecen-1-ol
Roseoside
3-heptadecen-5-yne, (Z)-



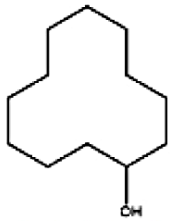
Sucrose



Trichloroacetic acid, tridec-2-ynyl ester

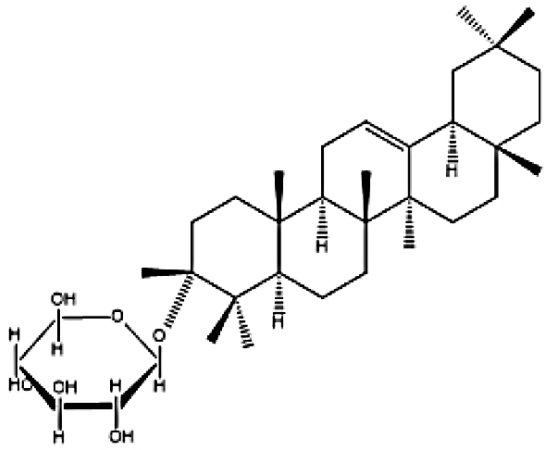


L-(+)- Ascorbic acid 2,6-dihexadecanoate

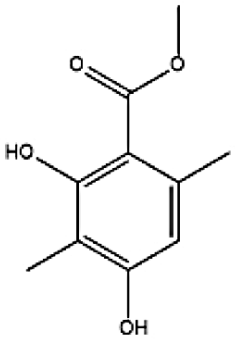


Cyclododecanol

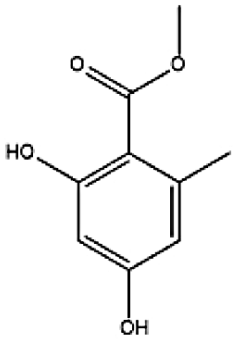
n-Heneitriacontane



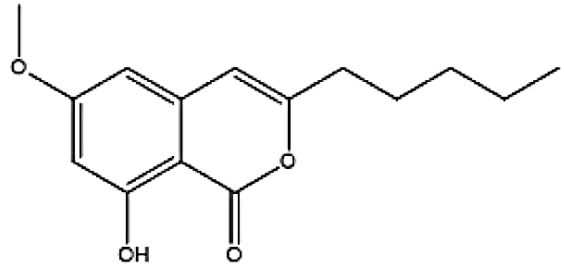
Olean-12-en-3α-ol-28-oic acid 3α-D-glucopyranoside



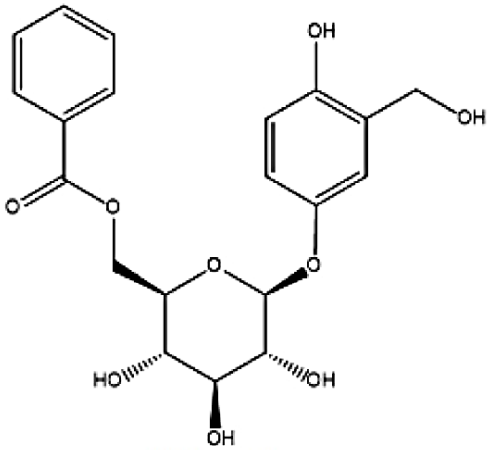
Atranic acid



Methyl orsellinate



8-Hydroxy-6-methoxy-pentylisocoumarin



Xylosmacin

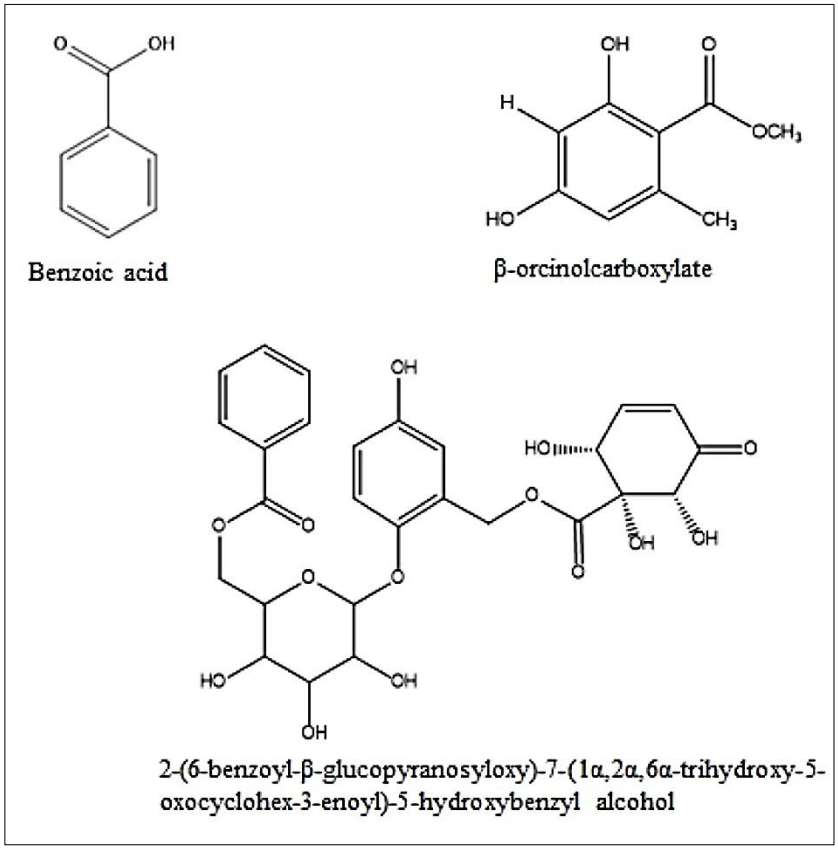


Fig 1: Structures of phytoconstituents isolated from *Xylosma longifolia* Clos.

Table 1: Reported phyto constituent of *Xylosma longifolia* Clos.

Phyto constituent category	Isolated from	Phyto constituent	References
Glycoside	Whole plant	Xylosmaloside	[35]
	Stem bark	Xylongoside A and xylongoside B	[39]
Flavonoid	Whole plant	Rutin and kaempferol-3-rutinoside	[35]
	Leaf	Kaempferol; kaempferol-3-rhamnoside; kaempferol-3-β-xylopyranoside-4'-α rhamnoside; quercetin; quercetin-3-rhamnoside; rutin and catechin	[40,41]
Triterpenoid	Leaf	β-amyrin and Friedelin	[38]
	Stem bark	Friedelin and epifriedelanol	[39]
Sterol	Leaf	β-sitosterol and phytol	[16,38]
Fatty acid	Leaf	n-Hexadecanoic acid; cis-13, 16-docasadienoic acid; 17-octadecynoic acid; 9, 12-octadecadienoic acid (Z, Z)-	[16]
Ester	Whole plant	Methyl caffeate	[35]
Amino acid derivative	Leaf	N,N-dimethylglycine	[16]
Miscellaneous	Whole plant	Ethyl β-D-glucopyranoside and roseoside	[35]
	Stem bark	Benzoic acid; β-orcinolcarboxylate; 2-(6-benzoyl-β-glucopyranosyloxy)-7-(1α, 2α, 6α-trihydroxy-5-oxocyclohex-3-enoyl)-5-hydroxybenzyl alcohol; xylosmacin; atraric acid; methyl orsellinate and 8-hydroxy-6-methoxy-pentylisocoumarin	[39,42]
	Leaf	Olean-12-en-3α-ol-28-oic acid 3α-D-glucopyranoside; n-heneitriacontane; 3, 7, 11, 15-Tetramethyl-2-hexadecen-1-ol; 3-heptadecen-5-yne, (Z)-; trichloroacetic acid, tridec-2-ynyl ester; L-(+)-ascorbic acid 2,6-dihexadecanoate; cyclododecanol and sucrose	[16,38,43]

Pharmacological Activities

Although the literature on pharmacological activities of *X. longifolia* is available but in unorganized and scattered form. It is therefore, considered important to bring together the existing information. The plant exhibits antifungal, antibacterial, anti-dermatophytic and anti-tubercular properties [39-41]. The pharmacological properties possessed by the plant are briefly discussed below and also in Table 2.

1. Analgesic activity: Ghalib studied the analgesic activity of *X. longifolia* in Albino Charles foster rats [38]. The two doses (50 and 100mg/kg) of aqueous and alcohol leaf extracts were tested using Pentazocine as standard. Both extracts showed analgesic response in dose dependent manner. The alcoholic extracts gave better results than aqueous extract. Even the alcoholic leaves extracts were found more potent than the standard drug. Thus adding one more positive attributes to *X. longifolia* known medicinal properties and could be used as a pain killer.

2. Antibacterial activity: *X. longifolia* has shown a remarkable activity against diverse bacteria. The antibacterial

action of *X. longifolia* leaves extracts on gram-positive bacterial strains namely, *Bacillus subtilis* (MTCC-121), *Escherichia coli* (K-12), *Salmonella typhimurium* (MTCC-98) and *Staphylococcus aureus* (IAO-SA-22) was evaluated using Chloramphenicol as positive control. It was observed that *S. aureus* was most sensitive to aqueous and alcoholic leaves extracts while *B. subtilis* and *S. typhimurium* were moderately sensitive to both extracts [41].

3. Antifungal activity

Devi evaluated the antifungal potential of some medicinal plants under *in vitro* conditions [45]. Different plants or plant parts used were; whole plant of *Ageratum conyzoides* and *A. houstonianum*, leaf and bark of *Xylosma longifolia*, leaf of *Vitex trifolia*. Various plant crude extracts (petroleum ether, methanol, chloroform and water) were prepared and tested against American Type Culture Collection strains of *Candida viz*., *C. albicans* (ATCC 90029, ATCC 1162 and ATCC Y-9-19), *C. glabrata* (ATCC 91030), *C. parapsilosis* (ATCC 20019), *C. krusei* (ATCC 6258 and ATCC 71061-1113) and *C. kefyr* (ATCC1110). Different plant crude extracts exhibited antifungal properties in concentration depended manner. However, petroleum ether leaves crude extract of *X. longifolia* showed strong activity against *C. kefyr* with minimum inhibitory concentration of 62.25 µg/ml. In another study, aqueous and alcoholic leaves extracts of *X. longifolia* were investigated for their antifungal properties using Nystatin as standard. Both extracts showed different activity. The aqueous extract was highly effective against *Candida albican* while moderately effective against *Trichoderma viride.* The alcoholic extract also showed high activity against *Candida albican* whereas moderate activity against *Aspergillus brassicola* [41].

4. Anti-dermatophytic activity

X. longifolia displayed good efficacy against various skin diseases and infection. The leaf and stem bark exhibited anti-dermatophytic activity against fungal pathogens like *Microsporum boullardii* (MTCC 6059), *M. canis* (MTCC 2820 and MTCC 3270), *M. gypseum* (MTCC 2819), *Trichophyton ajelloi* (MTCC 4878), *T. rubrum* (MTCC 296 and MTCC 3272) [40]. The anti-dermatophytic activity of the solvent extracts of chloroform, methanol and petroleum ether were evaluated by agar well diffusion method using Dimethyl sulfoxide and Amphotericin-B as negative and positive controls. All solvent extracts of leaf and bark showed variation in the levels of activity against fungal pathogens. Among all leaf solvent extracts, petroleum ether showed potent inhibitory effect on the growth of *M. canis* (MTCC 3270) and *M. gypseum* (MTCC 2819), chloroform on *M. canis* 3270 while methanol on *T. ajelloi* (MTCC4878). Likewise, among bark solvent extracts, petroleum ether inhibited the growth of petroleum ether of *M. canis* (MTCC 3270), chloroform of *M. gypseum* (MTCC 2819) and methanol of *T. ajelloi* (MTCC 4878). Methanolic extracts of both leaf and bark showed most promising inhibitory effect on *M. canis* (MTCC 3270) and *T. ajelloi* (MTCC 4878).

The minimum inhibitory concentrations (MICs) of the crude extracts against fungal pathogens were determined by micro wells dilution method. *M. canis* (MTCC 3270) and *T. ajelloi* (MTCC 4878) were found most susceptible to chloroform and methanol leaf extracts of *X. longifolia*, respectively. The MICs of different leaf extracts on *M. boullardii* (MTCC 6059), *M. canis* (MTCC 2820), *M. canis* (MTCC 3270), *M. gypseum* (MTCC 2819), *T. ajelloi* (MTCC 4878), *T. rubrum* (MTCC 296), *T. rubrum* (MTCC 3272) were 2.25, 2.25, 0.5625, 1.125, 0.140625, >9 and >9 mg/ml, respectively. Similarly, MIC values of bark extracts on *M. boullardii* (MTCC 6059), *M. canis* (MTCC 2820), *M. canis* (MTCC 3270), *M. gypseum* (MTCC 2819), *T. ajelloi* (MTCC 4878), *T. rubrum* (MTCC 296), *T. rubrum* (MTCC 3272) were >9, >9, 0.5625, 2.25, 0.28125, 2.25 and 2.25 mg/ml, respectively. It was observed that leaf of *X. longifolia* possessed better anti-dermatophytic properties than bark. Leaf methanolic extract showed highest sensitivity against *T. ajelloi* MTCC 4878 (MIC= 0.140625 mg/ml) [40].

5. Antioxidant activity

Till date only few studies have evaluated the anti-antioxidant property of *X. longifolia*. Bhattacharyya *et al*. reported that 95% methanol extract of *X. longifolia* leaves contained numerous secondary metabolites which exhibit anti-antioxidant activity [16]. Devi *et al*. evaluated DPPH scavenging activity values of petroleum ether, chloroform and methanol extracts of leaf and bark of *X. longifolia*. The scavenging capacity (SCa50) was recorded to be 0.7±0.2 to 1.4±0.04 mg/ml and 0.6±0.17 to 1.23±0.56 mg/ml in leaf and bark extracts, respectively [40].

6. Anti-tubercular activity

The antimicrobial assays with *X. longifolia* extracts revealed an inhibitory capacity against *Mycobacterium tuberculosis* strain H37Rv. Few compounds isolated from *X. longifolia* stem bark were tested for their anti-tubercular against *M. tuberculosis* using Rifampicin as positive control. Compound 8-hydroxy-6- methoxy-3-pentylisocoumarin showed highest activity with minimum inhibitory concentration value of 40.2 mg/mL. On contrary, other isolated compounds were found inactive. Thus, *X. longifolia* could be extensively utilized for treating tuberculosis [39].

Other Activities

1. Insecticidal activity

The insecticidal activity of *X. longifolia* was determined in *Helicoverpa armigera* larvae using three different stem bark extracts (chloroform, ethyl acetate and petroleum ether). Among all extracts, maximum phytotoxicity was observed in petroleum ether extract at more than 1% concentration. However, at 0.5% concentration, larvae repelled its food while higher concentration i.e. 1% and 2% showed complete anti-feedent response. The chloroform and ethyl acetate extract showed 52.58% and 73.97% mortality of larvae [38]. In similar study conducted by Choudhury, the bioefficacy and larvicidal potential of ethyl acetate, petrol and chloroform extracts of *X. longifolia* leaves against *H. armigera* was tested [46]. Maximum reduction in larval (49.32%) and pupal weight (46.24%) were observed at 2% concentration of ethyl acetate solvent. The range of reduction in larval weight noted to be 4.40 to 12.58% in petrol fraction and 4.42 to 11.85% in chloroform solvent. However, weight of pupa in both of these solvents was found to be close to normal control values. The ethyl acetate solvent *of X. longifolia* also caused 73.97% mortality of larvae.

2. Pest and pathogen management

The role of *X. longifolia* has been evaluated for the management of pest and pathogen in traditional agriculture. The leaves of *Vitex negundo* and *X. longifolia* were boiled together and the solution was incubated at room temperature for 2-3 days. The fermented liquid extract was sprayed over

the crops. It was observed that case worms, cut worms and leaf folders were controlled by the sprayed extract. When extract was sprayed at 20% concentration, rice blast and brown spot of rice was also managed to some extent. It was suggested that the foul smell of the extract helped to repel the pests. The farmers of remote areas of Manipur (India) still use mixture of copper, *Adhatoda vasica*, *Azadrirachta indica*, *Cedrela toona*, *Vitex negundo*, and *Xylosma longifolia* dissolved in water to control pests and pathogens of rice. The solution exhibited antimicrobial properties and repelled the insect pests [47].

3. Served as host plant: Gokhale and Yathumon for the first time reported that *X. longifolia* served as a local host for *Vagrans egista sinha* in Dehradun, Uttarakhand (India) [48]. *V. egista sinha* not only feed on leaves of *X. longifolia* but also preferred to lay eggs on leaves of host plant rather than on spider webs.

4. Used for beekeeping in bee farm
In bee farms of Punjab, bees are commonly rear on *Cedrela toona*, *Dalbergia sissoo*, *Sapindtts detergens* and *Prumts cerasoides* as they are major source of nectars. However, during dreath period when there is shortage of nectar-producing flowers, plants like *Xylosma longifolia*, *Brassica campestris*, *Cassia fistula* and other flowering plants help the bees to overcome this period [49].

Table 2: Pharmacological activities of *Xylosma longifolia* Clos.

Plant part used	Extract	Model	Activity	References
Leaf	Aqueous and alcohol	Albino Charles foster rats	Analgesic activity	[38]
Leaf	Aqueous and alcohol	*Escherichia coli*, *Staphylococcus aureus*, *Salmonella typhimurium* and *Bacillus subtilis*	Antibacterial activity	[41]
Leaf	Petroleum ether	*Candida albicans* (ATCC 90029, ATCC 1162, ATCC Y-9-19), *C. glabrata*, *C. parapsilosis*, *C. krusei* (ATCC 6258, ATCC 71061-1113) and *C. kefyr*	Antifungal activity	[45]
Bark	Petroleum ether	*Candida albicans*, *C. glabrata*, *C. parapsilosis*, *C. krusei* and *C. kefyr*	Antifungal activity	[45]
Leaf	Aqueous and alcohol	*Candida albicans*, *Fusarrium oxysporum*, *Penicillium notatum*, *Aspergillus niger and Trichoderma viride*	Antifungal activity	[41]
Stem bark and leaf	Petroleum ether, chloroform and methanol	*Microsporum boullardii*, *M. canis*, *M. gypseum*, *Trichophyton ajelloi*, *T. rubrum*	Anti-dermatophytic activity	[40]
Leaf	95% Methanol		Antioxidant activity	[16]
Stem bark and leaf	Petroleum ether, chloroform and methanol		Antioxidant activity	[40]
Stem bark	Methanol	*Mycobacterium tuberculosis* strain H37Rv	Anti-tubercular activity	[39]
Leaf	Chloroform, ethyl acetate and petroleum ether	*Helicoverpa armigera*	Insecticidal activity	[38]
Leaf	Ethyl acetate, petrol and chloroform	*Helicoverpa armigera*	Reduced larval and pupal weight	[46]
Leaf	Juice/extract	Humans	Jaundice treatment	[22]

Conclusion
The present review gives a thorough and systematic overview of distribution, morphology, traditional applications, phytochemistry and biological activities of *X. longifolia*. The plant is widely used in folk medicine for the treatment of various diseases in many regions of world, particularly in India. It is a source of various chemical compounds which have broad spectrum of bioactivities. Therefore, *X. longifolia* can prove to be a reservoir of chemical compounds and a new task for chemists to discover more active molecules from it. The conscientious efforts are required to evaluate the potential of *X. longifolia* and validate its traditional uses through clinical applications so that use of this plant can go beyond ethnobotanical reports.

Conflicts of interest
The authors claim no conflict of interests.

References

1. Dar RA, Shahnawaz M, Qazi PH. General overview of medicinal plants: A review. J Phytopharm. 2017;6(6):349-351.
2. Sharma G, Moin S. Medicinal plants: A mini review. J Environ Sci Technol. 2020;6(1):14-18.
3. Farnsworth NR, Akerele O, Bingel AS, Soejarto DD. Guo Z. Medicinal plants in therapy. Bull World Health Organ. 1985;63(6):965.
4. Farnsworth NR, Soejarto DD. Global importance of medicinal plants. In: Akerele O, Heywood V and Synge H. (Eds), The Conservation of Medicinal Plants. Cambridge University Press, Cambridge, UK, 1991.
5. Schippmann U, Leaman DJ, Cunningham AB. Impact of cultivation and gathering of medicinal plants on biodiversity: Global trends and issues. Inter-department working group on biology diversity for food and agriculture, FAO, Rome, Italy, 2002.
6. Shiva V. Protecting our biological and intellectual heritage in the age of biopiracy. The Research Foundation for Science, Technology and Natural Resources Policy, New Delhi, India, 1996.
7. Rajkumari S, Sanatombi K, Biodiversity and conservation of medicinal plants. In: Kshetrimayum B (Ed.), Medicinal Plants and Its Therapeutic Uses. OMICS Group eBooks, Foster City, USA, 2017.
8. Hau BC, So KK. Using native tree species to restore degraded hillsides in Hong Kong, China, 2002, 179-190.

9. Khare CP. Indian medicinal plants: An illustrated dictionary. Springer-Verlag, Berlin Heidelberg, New York, 2007, 725.
10. Ahmed E, Arshad M, Saboor, A, Qureshi R, Mustafa G, Sadiq S, *et al*. Ethnobotanical appraisal and medicinal use of plants in Patriata, New Murree, evidence from Pakistan. J Ethnobiol Ethnomedicine 2013;9(1):1-10.
11. Vo VC. Dictionary of Vietnamese Medicinal Plants. Medicine Publishing, Hanoi, 1999, 1085.
12. Khumbongmayum AD, Khan ML, Tripathi RS. Ethnomedicinal plants in the sacred groves of Manipur. Indian J Tradit Knowl. 2005;4(1):21-32.
13. Adhikari BS, Babu MM, Saklani PL, Rawat GS. Medicinal plants diversity and their conservation status in Wildlife Institute of India (WII) campus, Dehradun. Ethnobot leafl. 2010;14:46-83.
14. World Flora Online. http://www.worldfloraonline.org/taxon/wfo-0001063055#synonyms; 2021.
15. E Flora of India. https://sites.google.com/site/efloraofindia/species/mz/s/salicaceae/xylosma/ xylosma-longifolia.
16. Bhattacharyya R, Boruah JS, Medhi KK, Borkataki S. Phytochemical analysis of leaves of *Xylosma longifolia* Clos: A plant of ethnomedicinal importance. Int J Pharm Sci Res. 2020b;11(5):2065-2074.
17. Flora of China. http://www.efloras.org/flora_page.aspx?flora_id=2 [accessed August 2016]' Missouri Botanical Garden, St. Louis, MO & Harvard University Herbaria, Cambridge, MA; 2008.
18. Catalogue of Life. https://www.catalogueoflife.org/data/taxon/5CMQ6; 2015.
19. Digital Flora of Eastern Ghats. http://flora-peninsulaindica.ces.iisc.ac.in/EasternGhats/ herbsheet.php?id=1951&cat=4.
20. India Biodiversity Portal. https://indiabiodiversity.org/species/show/278458#summary.
21. Ahuja U, Thakrar R, Ahuja SC. Alcoholic rice beverages. Asian Agri-Hist. 2001;5(4):309-319.
22. Bhattacharyya R, Medhi KK, Borthakur SK, Borkataki S. An ethnobotanical study of medicinal plants used against jaundice by tea tribes of Morigaon district, Assam (India). J Nat Remedies 2020a;20(1):16-28.
23. Chadha HR. The wealth of India raw materials. Publication and Information Directorate, New Delhi, CSIR. 2003;XI:11.
24. Khatoon R, Singh AKDP, Dutta BK. Ethnoveterinary plants used by Kom tribe of Manipur, India. In: Singh KK, Das KC, Lalruatsanga H. (Eds.), Bioresources and Traditional Knowledge of Northeast India. Mizo Post Graduate Science Society Publishers, Aizawl, India, 2013, 303-306.
25. Kom LE, Tilotama K, Singh TD, Rawat AKS, Thokchom DS. Ethno-medicinal plants used by the Kom community of Thayong village, Manipur. J Ayurvedic Herb Med. 2018;4(4):171-179.
26. Sinha SC. Medicinal plants of Manipur, (Manipur Association for Science & Society (MASS), Manipur Cultural Integration Conference (MCIC) Publishers, Palace Compound, Calcutta, Manasi Printers, 1996.
27. Salam S. Medicinal plant used for the treatment of muscular sprain by the Tangkhul tribe of Ukhrul district, Manipur, India. Int J Adv Res. 2020;8(12):167-170.
28. Ningthoujam SS, Talukdar AD, Potsangbam KS, Choudhury MD. Traditional uses of herbal vapour therapy in Manipur, North East India: an ethnobotanical survey. J Ethnopharmacol. 2013;147(1):136-147.
29. Yuhlung CC, Bhattacharyya M. Indigenous medicinal plants used by the Maring tribe of Manipur, Northeast India. J Ayu Her Med. 2016;2(4):146-153.
30. Singh TT, Sharma HM, Devi AR, Sharma HR. Plants used in the treatment of piles by the scheduled caste community of Andro village in Imphal East District, Manipur (India). J Plant Sci. 2014;2(3):113-119.
31. Singh TT, Devi AR, Sharma HM. Ethnopharmacological survey of medicinal plants in Andro village in Manipur (India). Res J Life Sci Bioinform Pharm Chem Sci. 2018;4(5):606-626.
32. Safeeulla KM, Govindu HC. Some new hosts of *Cephaleuros*. Bangalore Press, 1948.
33. Marpa S, Samant SS, Tewari A, Paul S. Diversity and indigenous uses of plants in Naina Devi Sacred Shrine Rewalsar, Himachal Pradesh, North Western Himalaya, India. Int J Chem Stud. 2020;8(2):1265-1276.
34. Mir AH, Upadhaya K, Choudhury H. Diversity of endemic and threatened ethnomedicinal plant species in Meghalaya, North-East India. Int Res J Environ Sci. 2014;3(12):64-78.
35. Swapana N, Noji M, Nishiuma R, Izumi M, Imagawa H, Kasai Y, *et al*. A new diphenyl ether glycoside from *Xylosma longifolium* collected from north-east India. Nat Prod Commun. 2017;12(8):1273-1275.
36. Gulia KK, Radhakrishnan A, Kumar VM. Approach to sleep disorders in the traditional school of Indian medicine: alternative medicine II. In: Sleep Disorders Medicine, Springer, New York, 2017, 1221-1231.
37. Kong YC, Jing-Xi X, But PPH. Fertility regulating agents from traditional Chinese medicines. J Ethnopharmacol. 1986;15(1):1-44.
38. Ghalib RM. Chemical and biological studies of extracts of medicinal plants. Thesis. Department of Chemistry, Aligarh Muslim University, Aligarh (India), 2008.
39. Truong BN, Pham VC, Mai HDT, Nguyen MC, Nguyen TH, Zhang HJ, *et al*. Chemical constituents from *Xylosma longifolia* and their anti-tubercular activity. Phytochem Lett. 2008;4(3):250-253.
40. Devi WR, Singh SB, Singh CB. Antioxidant and anti-dermatophytic properties leaf and stem bark of *Xylosma longifolium* clos. BMC Complementary Altern Med. 2013;13(1):1-9.
41. Parveen M, Ghalib RM. Flavonoids and antimicrobial activity of leaves of *Xylosma longifolium*. J Chil Chem Soc. 2012;57(1):989-991.
42. Ngân TB, Cương PV, Soejarto DD. Research of chemical composition of long leaf Mochuong (*Xylosma longifolium* Clos). Tạp chí Hóa học. 2009;47(4A):405-408.
43. Sultana S, Ali M, Jameel M. Aliphatic constituents from the leaves of *Dillenia indica* L., *Halothamus bottae* Jaub. and *Xylosma longifolium* Clos. Chem Res J. 2018;3(3):109-117.
44. Devi KU, Devi TI, Chand T. Chemical composition of three medicinal plants use as traditional medicine in Manipur. Am J PharmTech Res. 2017;7(4):152-162.

45. Devi WR. Screening of certain medicinal plants of Manipur for their antifungal activity against *Candida* species. In: Advances in Pharmaceutical Biotechnology: Recent Progress and Future Applications, Springer Nature Singapore, 2020, 155-162.
46. Choudhury RA. Population dynamics and management of *Helicoverpa armlgera* (Hubner) (Lepidoptera: Noctuidae) on *Cicer arietinum* L. Thesis. Department of Plant Protection, Faculty of Agricultural Sciences, Aligarh Muslim University, Aligarh (India), 2010.
47. Santosh T, Chhetry GKN. Agro-biodiversity management related ITKs in North-Eastern India. J Biol Agric Healthcare. 2012;2(6):83-92.
48. Gokhale P, Yathumon MA. Descriptions of the early stages of *Vagrans egista sinha* (Lepidoptera: Nymphalidae) with notes on its host plant *Xylosma longifolia* Clos from the western Himalaya of India. J Threat Taxa. 2021;13(8):19144-19148.
49. Khan AR. Progress of Beekeeping in the Punjab. Bee World. 1945;26(6):42-44.