NPC Natural Product Communications

2018
Vol. 13
No. 11
1557 - 1567

A Review of Common Medicinal Plants in Chin State, Myanmar

Zaw Min Thu[a,*], Mya Mu Aye[b], Hnin Thanda Aung[b], Myint Myint Sein[b] and Giovanni Vidari[c]

[a]*Department of Chemistry, Kalay University, Kalay, Myanmar*
[b]*Department of Chemistry, Mandalay University, Mandalay, Myanmar*
[c]*Department of Chemistry and CEMEC, University of Pavia, Via Taramelli 12, 27100, Pavia, Italy*

zawminthu87@gmail.com; cistre@unipv.it

Received: March 22nd, 2018; Accepted: August 30th, 2018

Promising sources of novel bioactive compounds include plants growing in several third-world countries where the local flora is still largely uninvestigated. A paradigmatic example is represented by medicinal plants growing in Myanmar, especially in Chin State, in northwestern Myanmar. This is one of the least developed areas of the country where the people still use natural remedies derived from a rich biodiversity. This review mainly covers the investigations done on phytochemical constituents and biological activities of 20 medicinal plants, namely *Alangium chinense*, *Anemone obtusiloba*, *Anneslea fragrans*, *Antidesma bunius*, *Croton oblongifolius*, *Embelia tsjeriam-cottam*, *Ficus heterophylla*, *Gaultheria fragrantissima*, *Hydnocarpus kurzii*, *Leea macrophylla*, *Leucas cephalotes*, *Millingtonia hortensis*, *Myrica nagi*, *Olax scandens*, *Pimpinella heyneana*, *Pterospermum semisagittatum*, *Ruellia tuberosa*, *Smilax zeylanica*, *Stemona burkillii*, and *Tadehagi triquetrum*, that have long been used in the Chin State for curing various diseases. These plants have been selected on the basis of their medicinal uses not only in Myanmar but also in the related Ayurvedic healing system. Moreover, besides their medicinal importance, most of them grow in the Chin State more abundantly than in other regions of Myanmar. Although the efficacy of some of these plants have been verified scientifically, the chemical constituents and biological activities of most of them still need to be investigated to confirm the claimed therapeutic effects.

Keywords: Myanmar, Chin State, Medicinal plants, Phytochemical constituents, Biological activities.

Myanmar is a country with a rich cultural heritage and comprises more than 100 ethnic groups, among which Chin people are a major one. Chin State, which remains one of the least developed and poorest areas of the country, lays in the northwestern Myanmar, approximately between North Latitude 20° 35' and 24° 05' and East Longitude between 92° 20' and 94° 05'. It borders India in the northwest and Bangladesh in the southwest, extending over a mostly mountainous area of 13,906 square miles, with hills densely covered by subtropical rainforests and separated by vast valleys and gorges. Mt Victoria is the state's highest peak with an altitude of 3100 meters above sea level. The climate is typically temperate with three seasons like other regions of Myanmar. In the rainy season, southwestern monsoon winds bring abundant rainfall to the Chin State, creating a habitat that favors the explosive growth of countless plants.

Although the origin of traditional medicine in Myanmar, which is practiced over the entire country and exists from time immemorial, is unidentifiable, Buddhist philosophy has influenced the traditional art of healing, as most people practice Buddhism. The traditional medicine is also based on Ayurvedic concepts, which originated from the Indian system of medicine. Indeed, knowledges about medicinal plants are mainly retained by monks in the local language which is hardly accessible to a wide audience.

Recently, there has been in Myanmar a fast development of private and government pharmaceutical companies dealing with traditional plants. They manufacture massive amounts of registered drugs according to the GMP (Good Manufacturing Practice) standards and obtain quality raw materials from natural forests and herbal gardens around the country. In this way, many states of Myanmar, including the Chin State, are rapidly losing resources from their biodiversity. Therefore, it is important to protect the variety of Myanmar medicinal plants and to preserve the traditional knowledges about plants used in local healing systems, raising the awareness of the scientific community and common people via easily accessible documents.

As a part of our ongoing project on the phytochemistry of traditional medicinal plants of Myanmar, we report in this paper, for the first time, a complete account about the uses of a few plants widely used in the Myanmar and Ayurvedic traditional medicine, which grow in the Chin State more abundantly than in other regions of Myanmar. Moreover, the chemical components reported in the literature and their biological and pharmacological activities are described, although investigations have mainly been performed on plant samples collected in other Asian countries. In addition, the therapeutic applications of these plants are highlighted. All the information have been condensed in Table 1.

The ethnomedicinal relevance of the selected medicinal plants is primarily based on direct documentation and information collected from traditional medicine practitioners who know and use medicinal plants for treating a variety of ailments, while a few therapeutic applications are part of the popular knowledge of local people.

***Alangium chinense* (Lour.) Harms:** *A. chinense* is a deciduous shrub and belongs to the family Alangiaceae. The plant commonly occurs in China while it is rarely found in some subtropical areas of Myanmar. It is locally used for the treatment of piles in Myanmar. Other documented uses include the plant as a sedative, anthelmintic [1], muscle relaxant and analgesic agent [2]. Itoh *et al.* reported, as chemical constituents of the leaves, 6'-*O*-*trans*-caffeoylsalicin [3], 6'-*O*-β-D-xylopyranosylsalicin [3-5], benzyl alcohol β-D-glucopyranosyl(1→2)-[β-D-xylopyranosyl-(1→6)]-β-D-glucopyranoside, 2'-*O*-β-D-glucopyranosylsalicin, 2'-*O*-β-D-glucopyranosyl-6'-*O*-β-D-xylopyranosylsalicin, benzyl alcohol β-D-xylopyranosyl(1→6)-β-D-glucopyranoside, (*Z*)-hex-3-en-l-ol β-D-xylopyranosyl (1→6)-β-D-glucopyranoside [4], salicin, 4',6'-*O*-(*S*)-hexahydroxydiphenoylsalicin, 6'-*O*-β-glucopyranosylhenryoside [4-5], 6'-*O*-galloylsalicin (**1**), 4',6'-di-*O*-galloylsalicin, 4',6'-*O*-(*R*)-hexahydroxydiphenoylsalicin, pyrocatechol 1-*O*-β-D-xylopyranosyl (1→6)-β-D-glucopyranoside, (6*S*,9*R*)-roseoside, 6'-*O*-*trans*-caffeoylsalicin, benzyl alcohol β-D-xylopyranosyl (1→6)-β-D-glucopyranoside, quercetin

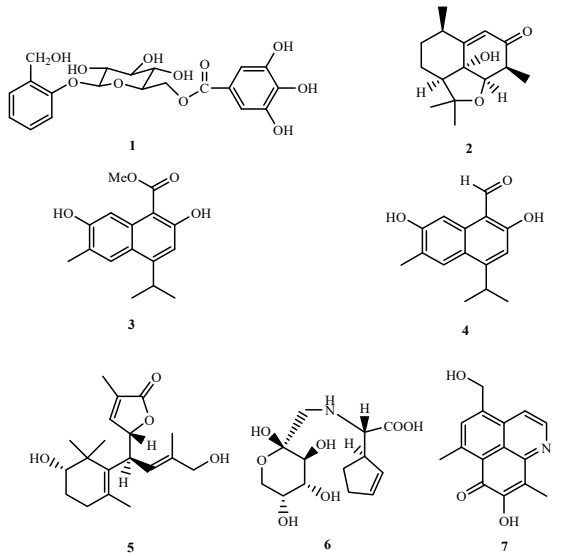


Figure 1: Some compounds isolated from *Alangium chinense*.

3-*O*-β-D-xylopyranosyl(1→2)-β-D-galactopyranoside, kaempferol 3-*O*-β-D-glucopyranosyl (1→2)-β-D-galactopyranoside, kaempferol 3-*O*-β-D-xylopyranosyl (1→2)-β-D-galactopyranoside, quercetin 3-*O*-β-D-glucopyranosyl (1→2)-β-D-galactopyranosie, hyperin, phenethyl alcohol β-D-xylopyranosyl (1→6)-β-D-glucopyranoside, demethylalangiside [5]. The roots of *A. chinense* have been reported to contain (3*S*,4*R*,5*S*,8*R*,10*R*)-tetrahydroperezinone **(2)**, (1*S*)-1-methoxylacinilene C, β-naphthol derivatives **3** and **4**, *N*-hydroxybenzylanabasine (racemic mixture), (2*R*)-*N*-hydroxybenzylanabasine, (2*S*)-*N*-hydroxybenzylanabasine, 2-hydroxy-*N*-hydroxybenzylanabasine, (2*S*)-2-hydroxy-*N*-hydroxybenzylanabasine, (2*R*)-2-hydroxy-*N*-hydroxybenzylanabasine, 8-hydroxy-3,6,9-trimethyl-7*H*-benzo[de]quinolin-7-one, (2*S*)-*N*-hydroxybenzylanabasine, 4,5-dimethoxycanthin-6-one, lacinilene C, 7-hydroxycadalene, 2,7-dihydroxycadalene, mansonone E, mansonone H, mansonone C, (1*S*,4*R*)-7,8-dihydroxycalamenene [6], (2*S*,7*S*,11*S*)-(8*E*,12*Z*)-2,10-dihydroxypellialactone (**5**), (2*S*,4*S*,7*S*,11*S*)-(8*E*,12*Z*)-2,4,10-trihydroxypellialactone, (11*S*)-6-hydroxy-5-(11-hydroxypropan-12-yl)-3,8-dimethyl-2*H*-chromen-2-one, (3*S*,4*R*,5*S*,8*S*,10*S*)-tetrahydroperezinone, (3*S*,4*R*,5*S*,8*S*,10*S*,11*R*)-12-hydroxy-tetrahydroperezinone, (5*S*,8*R*)-2-hydroxy-3,8-dimethyl-5-vinyl-5,6,7,8-tetrahydronaphthalene-1,4-dione, mansorin I, (6*S*,9*R*)-vomifoliol, (6*S*,9*S*)-vomifoliol, (+)-*S*-dehydrovomifoliol, megastigm-5-ene-3,9-diol, (4*R*,9*R*)-megastigm-5-ene-3,9-diol, (4*S*,9*R*)-megastigm-5-ene-3,9-diol, (6*S*,9*S*)-dihydrovomifoliol, 3-oxo-7,8-dihydro-α-ionol, 3-oxo-α-ionol, (6*Z*,9*S*)-9-hydroxy-4,6-megastigmadien-3-one, 3-hydroxy-4-oxo-7,8-dihydro-β-ionol, 4-oxo-β-cyclo-homogeraniol, 3-oxo-α-ionone, 3-hydroxy-β-cyclo-homogeraniol, 3-(3'-hydroxybutyl)-2,4,4-trimethylcyclohexa-2,5-dienone, 3-hydroxy-β-damascone, 3-oxo-β-ionol, (6*S*,9*R*)-roseoside, foliasalacioside B1, eleganoside A, platanionoside G [7], (7*R*,8*R*)-*threo*-4,7,9,9'-tetrahydroxy-3,5,2'-trimethoxy-8-*O*-4'-neolignan, 2-(hydroxymethyl)phenol 1-*O*-β-D-glucopyranose-(1→6)-*O*-α-L-rhamnopyranoside, 2-(ethoxy--methyl)phenol 1-*O*-β-D-glucopyranoside [8], alanchinin (**6**), 7-*O*-β-glucopyranosylsalicin, 2-(2'-cyclopentenyl)glycine, salicin 6'-*O*-β-D-apiofuranoside, 6''-*O*-β-D-glucopyranosylhenryoside, 5β,6β-dihydroxycyclohex-2-en-1-*O*-β-glucopyranoside, cuneataside D, 4-cyclohexene-1,2,3-triol, loganic acid, 4,4'-di-*O*-methylellagic acid, β-glucogallin and edulilic acid [9], henryoside [4-5,9], loganic acid [5,9], 8-hydroxy-3-hydroxymethyl-6,9-dimethyl-7*H*-benzo[de]isoquinoline-7-one (**7**), 4,5-dimethyoxycanthine-6-one, and hydroxybenzylanabasine [10]. According to Zhang *et al.*, the compounds isolated from *A. chinense* exhibit neuritis inhibitory activities [6], and antiviral [6-7] and antioxidant properties [8]. Xing *et al.* reported that compound **7** showed significant cytotoxicity against NB4, A-549, SHSY5Y, PC-3 and MCF-7 cell lines [10].

Anemone obtusiloba **D.Don:** *A. obtusiloba* is a flowering plant of the family Ranunculaceae, native to the Himalayan and mountainous regions of Myanmar. This plant is used for treating spleen ailments, anxiety neurosis, nervous exhaustion, tension, headache, migraine, insomnia, inflammation of ovaries, painful menstruation, genitourinary infections and as an antispasmodic remedy, while the seed oil is used to cure arthritis [1,11]. The presence of triterpene saponins, obtusilobinin, obtusilobin [12], and obtusilobicinin has been reported [13]. Kaushik *et al*. reported that the ethanolic extract of the stems has significant antimicrobial activity against *Staphylococcus aureus* and *Escherichia coli* [14].

Anneslea fragrans **Wall:** *A. fragrans* (family Theaceae) grows in forests and mountains of some southeast Asian countries. In Myanmar, it is used to treat mouth and gallbladder diseases, asthma, and as a blood purifier [15]. Although no work has been done on the chemical constituents, a methylene chloride extract of leaves exhibited potent antimalarial activity on *Plasmodium falciparum* (IC_{50} = 8.6 μg/ml) and a selectivity index (SI), i.e., a ratio of cytotoxicity on MRC5 cells to antiplasmodial activity, equal to 8 [16].

Antidesma bunius **(L.) Spreng:** *A. bunius* is a fruit tree, belonging to the family Euphorbiaceae. It is native to Southeast Asia. Leaf extract of *A. bunius* has been used to treat syphilis [17], whereas roots and barks are used to cure insect bites and stings [17]. Phytochemical investigations of this plant have detected the presence of dammaradienol, friedelin, epifriedelanol, β-sitosterol [18], corilagin, gallic acid, ferrulic acid, ellagic acid, vicinin II [19], amentoflavone [18-19], antidesoside, podocarpusflavone A, amentoflavone, byzantionoside B, (6*S*,9*R*)-roseoside [20], catechin, procyanidin B1 and procyanidin B2 [21]. *A. bunius* was reported to show antioxidant [22-24], antidiabetic [25-29], antimicrobial [30], pesticide [31], and cytotoxic activities [32].

Croton oblongifolius **Roxb.:** *C. oblongifolius* is a medium-sized tree, belonging to the family Euphorbiaceae. It is distributed in many parts of Myanmar as well as in other Asian countries. This plant is famous in Myanmar for its medicinal properties. The roots and barks are used to treat dyspepsia, dysentery, hepatitis, pulmonary edema, abscess, and fever. The chemical constituents of the stem bark have been intensively investigated and several compounds have been isolated: (+)isopimara-7(8),15-diene-19-oic acid [33], 11-dehydro(-)-hardwickic acid [34], crotohalimaneic acid (**8**), crotohalimoneic acid, 12-benzoyloxycrotohalimaneic acid [35], β-sitosterol, oblongifoliol [36], labda-7,12(*E*),14-triene, labda-7,12(*E*),14-triene-17-al, labda-7,12(*E*),14-triene-17-ol [37], labda-7,12(*E*),14-triene-17-oic acid [37-38], labda-12(*Z*),14,17-triene-18-oic acid [38], 2-acetoxy-3-hydroxy-labda-8(17),12(*E*)-14-triene, 3-acetoxy-2-hydroxy-labda-8(17),12(*E*)-14-triene, 2,3-dihydroxy-labda-8(17),12(*E*),14-triene [39], 3-hydroxycleistantha-13(17),15-diene, 3,4-*seco*-cleistantha-4(18),13(17),15-trien-3-oic acid [40], *ent*-3,4-*seco*-17-oxo-kaur-4(19),15(16)-dien-3-oic acid (**9**), *ent*-3,4-*seco*-kaur-4(19),16(17)-dien-3-oic [41], crotocembraneic acid (**10**), neocrotocembraneic acid [42], neocrotocembranal [43], furanocembranoid 1-3, furanocembranoid 4 [44], 3,4,15,16-diepoxy-cleroda-13(16),14-diene-12,17-olide, 3(3'-methoxy-5'-phenylfuran-2'-yl)propan-1-ol (**11**) [45], methyl 15,16-epoxy-3,13(16),14-*ent*-clerodatrien-18,19-olide-17-carboxylate, dimethyl 15,16-epoxy-12-oxo-3,13(16), 14-*ent*-clerodatriene-17,18-dicarbo-

xylate, nasimalun A, nasimalun B, levatin, (-)-hardwickiic acid, 15-hydroxy-*cis*-*ent*-cleroda-3,13(*E*)-diene, patchoulenone [46], crovatin [46-47], croblongifolin, nidorellol [47], oblongionoside A-F, kaempferol 3-*O*-β-D-(2"-*O*-β-D-apiofuranosyl)glucopyranoside 7-*O*-α-L-rhamnopyranoside, kaempferol 3-*O*-β-D-(2"-*O*-β-D-apiofuranosyl, 6"-*O*-α-L-rhamnopyranosyl)glucopyranoside 7-*O*-α-L-rhamnopyranoside, kaempferitrin, clerspide A, icariside F2, canthoside A, dendranthemoside A, glochidionioside D [48], stigma 5(6)-ene-3-β-*O*-(β-D-glucopyranoside)-20-β-ol, and β-sitosterol-3-*O*-β-D-glucopyranoside [49]. Athikomkulchai *et al*. studied the essential oil of the stem bark of *C. oblongifolius* and reported the presence of terpinen-4-ol (17.8%), α-guaiene (7.9%), (*E*)-caryophyllene (7.0%), (+)-cyclosativene (5.1%), aciphyllene (4.7%), germacrene D (3.2%), myrcene (6.7%), sabinene (4.8%), γ-terpinene (3.4%), progostol (4.6%) and α-muurolol (3.2%) as the dominant compounds [50]. Reported biological activities of this plant include cytotoxic [35,39-40,43-47], antibacterial [50], and hepatoprotective properties [51].

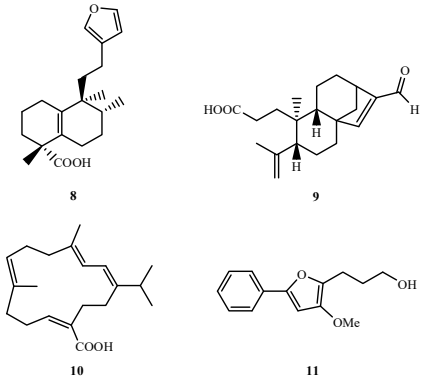


Figure 2: Some compounds isolated from *Croton oblongifolius*.

***Embelia tsjeriam-cottam* A. DC.:** *E. tsjeriam-cottam* (family Myrsinaceae) is a rambling shrub distributed in hilly regions of Myanmar, India and Sri Lanka. The fruits of *E. tsjeriam-cottam* have striking medicinal properties. In fact, they have been used to treat various diseases as a vermifuge, carminative, stimulant, stomachic, antimalarial and wound healing remedy [11]. Moreover, the fruits are used to cure chronic bronchitis and spleen enlargement [11]. According to the literature, embelin (**12**) is the major active constituent of the fruits of *E. tsjeriam-cottam* [52-56] and is the only secondary metabolite reported so far. A number of important biological activities, including hepatoprotective [53,58], chemopreventive [53], cytotoxic, antimicrobial, antitubercular, antimycotic [54], antioxidant [56], and anti-inflammatory effects [57], have been attributed to the fruits.

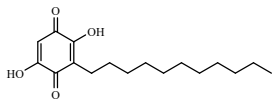


Figure 3: Embelin isolated from *Embelia tsjeriam-cottam*.

***Ficus heterophylla* L.f.:** *F. heterophylla* is a rambling shrub belonging to the family Moraceae. It is typically found in humid habitats of Southeast Asia. The roots are used for the treatment of flatulence and asthma, while the leaves are used to treat dysentery [17]. So far, there is no report about the phytochemical constituents and biological activities of this plant.

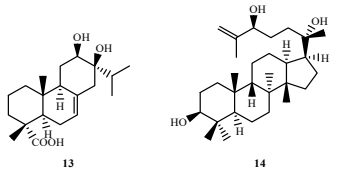
***Gaultheria fragrantissima* Wall.:** *G. fragrantissima*, belonging to the family Ericaceae, is an aromatic shrub which usually grows at high altitudes affected by heavy rainfall and permanent humid climate, in India, Myanmar, Sri Lanka, Nepal, Bhutan, and China. It is used to treat fever, headaches, inflammatory joint disorders and back pain, and also as an antifebrile and diuretic remedy [11]. Extensive phytochemical investigations of the constituents have led to the identification of quercetin 3-galactoside, ursolic acid [59], (+)-lyoniresinol-2α-*O*-β-L-arabinopyranoside, (+)-lyoniresinol-2α-*O*-β-D-glucopyranoside, (–)-isolariciresinol-2α-*O*-β-D-xylopyranoside [60], dhasingreoside, quercetin 3-*O*-β-D-galacturonopyranoside, quercetin 3-*O*-β-D-galactopyranoside, quercetin 3-*O*-β-D-glucuronopyranoside, quercetin 3-*O*-α-L-rhamnopyranoside, (–)-epicatechin, gaultherin [61], salicylic acid [61-62], *p*-hydroxybenzoic acid, *o*-pyrocatechuic acid, gentisic acid, protocatechuic acid, vanillic acid, *p*-coumaric acid, caffeic acid, ferulic acid [62], ethyl salicylate [63], 4-hydroxy-4-methyl-2-pentanone [64], methyl sailicylate [63-68], α-pinene, β-pinene, Δ^3-carene, longifolene, and caryophyllene oxide [69]. Pharmacological studies have highlighted the nematicidal [63], antioxidant [70], antifungal [71], and insecticidal properties [68,72] of *G. fragrantissima*.

***Hydnocarpus kurzii* (King) Warb.:** *H. kurzii,* (family Flacourtiaceae) is native to the tropical areas of India, Bangladesh, and Myanmar. Traditional medicine practitioners use the oil extracted from the seeds of *H. kurzii* to treat different health problems such as leprosy, skin diseases, intestinal worms, indigestion, blood poisoning. The plant has also been documented as a febrifuge [1]. Even though very little work has been done on the chemical constituents, the seeds of *H. kurzii* have been reported to contain fatty acids, such as chaulmoogric, gorlic, hydnocarpic, palmitic, palmitoleic, and oleic acids [73-74]. The aqueous and organic extracts of the leaves of *H. kurzii* have showed analgesic [75], antioxidant [76-77], antimicrobial [77], thrombolytic [78], and antihyperglycemic effects [79].

***Leea macrophylla* Roxb.:** *L. macrophylla*, belonging to the family Leeaceae is an herbaceous shrub widely distributed in Myanmar. It is also found in India, Nepal, Thailand, Laos, Cambodia, and Vietnam. In traditional medicine the plant is used to treat such different ailments as ringworm, inflammation, wound, bleeding and pain [17]. Mahmud *et al.* reported that an ethanolic extract of the roots contains oleanolic acid, stigmasterol, and 7α,28-dihydroxyoleanolic acid [80]. In several studies extracts of the plant have exhibited antioxidant [80-82,87], antimicrobial [82-83], wound healing [84], anti-inflammatory [85], anti-urolithiatic [86], neuroprotective [87], anti-nociceptive, and cytotoxic properties [88].

***Leucas cephalotes* Spreng.:** *L. cephalotes* is an annual rainy-season weed, belonging to the family Lamiaceae. It grows widely in the cultivated fields of Myanmar and other Asian countries such as India and China. In traditional medicine, *L. cephalotes* has been recommended as a natural remedy against several diseases such as jaundice, inflammation, asthma, fever, cough, malaria, anemia, sexual weakness in male [11,89], and as an antidote. Miyaichi *et al.* have reported that the whole herb of *L. cephalotes* contains leucasdins A, B, C (**13**), leucastrins A, B (**14**), oleanolic acid, 7-oxositosterol, 7-oxostigmasterol, 7α-hydroxysitosterol, 7α-hydroxy-stigmasterol, stigmasterol, 5-hydroxy-7,4'-dimethoxyflavone, pillion, gonzalitosin I, tricin, cosmosin, apigenin 7-*O*-β-D-(6-*O*-*p*-coumaroyl)glucopyranoside, anisofolin A and luteolin 4'-*O*-β-D-glucuronopyranoside [90]. Other phytochemical studies have shown the presence of β-sitosterol [91-92], its glucoside [91], (+)-stigmasterol, lupeol, oleanolic acid, laballenic acid, α-terpineol, methyl dodecanoate, methyl pelargonate, 1-ethyl-5,8a-dimethyl-1,3,4,6,7,8-hexahydro- naphthalen-2-one, dihydro-cis-α-copaene-8-ol, methyl myristate, 6,10,14-trimethylpentadecan-2-one, methyl

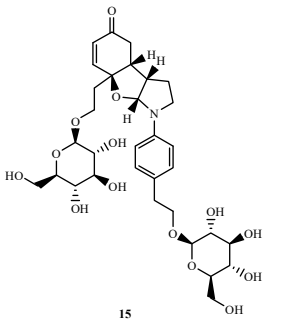
palmitate, methyl 8,11-octadecadienoic acid, linoleoyl chloride, and 6-octadecynoic acid [92]. Verma *et al*. studied the fatty acid content of all parts of *L. cephalotes* by GC/MS and reported the presence of caprylic acid, capric acid, lauric acid, azelaic acid, myristic acid, palmitic acid, palmitoleic acid, margaric acid, oleic acid, linoleic acid, linolenic acid, arachidic acid, behenic acid, tricosanoic acid, lignoceric acid, pentacosanoic acid, cerotic acid, montanic acid, melissic acid [93]. Many biological/pharmacological investigations have demonstrated that, potentially, *L. cephalotes* has many valuable applications such as anti-inflammatory [92,94-95], analgesic [94], antioxidant [96-97], antimicrobial [98-101], antifilarial [102], antifertility [103], antiplasmodial [104], hepatoprotective [105], and antidiabetic remedy [93,106].



13 **14**

Figure 4: Some compounds isoated from *Leucas cephalotes*.

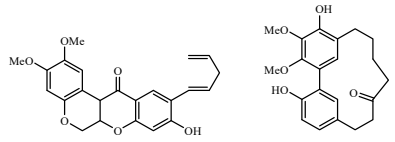
***Millingtonia hortensis* L.f.:** *M. hortensis*, a member of the family Bignoniaceae, is widely distributed and cultivated in many Asian countries. Flowers, leaves and roots of *M. hortensis* are used to treat headache, heart palpitations, hypertension and diabetes in traditional medicine [89]. Phytochemical studies of this plant have reported the isolation of scutellarein-5-galactoside [107], scutellarein [107-108], acetyl oleanolic acid [108], hispidulin [108-109,112], sitosterol [110], and *trans*-1-(2'-hydroxyethyl)cyclohexane-1,4-diol [111]. Hase *et al.* isolated from the flowers crisimaritin, pectolinarigenin, apigenin 7-*O*-glucoronide, hispidulin 7-*O*-glucoside, hispidulin 7-*O*-glucuronide methyl ester [112], millingtonine (**15**) [113], salidroside, 2-phenethyl rutinoside, 2-(3,4-dihydroxyphenyl)-ethyl glucoside, acteoside, *p*-coumaryl alcohol glucoside, isoeugenol glucoside, cornoside, racemic rengyolone, rengyoside B, rengyol, rengyoside A, isorengyol, 8-*O*-β-D-glucopyranosyl isorengyol, and nine cyclohexylethanoids, including four glucosides [114]. The plant has showed cytotoxic [115-116], antioxidant, hepatotoxic [117], antimicrobial [118-120], antimutagenic [121], and larvicidal activities [122-123].



15

Figure 5: Millingtonine isolated from *Millingtonia hortensis*.

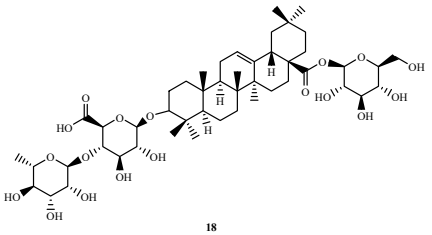
***Myrica nagi* Thunb.:** *M. nagi* (family Myricaceae) has a long history in traditional medicine for curing running nose, cough, toothache, earache, asthma, diarrhoea, liver complaints, piles, epilepsy and wounds [17]. The plant grows in the Himalayan region and also in highlands of Nepal and Myanmar. Isolated constituents include myriconol (**16**) [124], myricanol , myricanone (**17**) [125-127], gallic acid, epigallocatechin 3-*O*-gallate, epigallocatechin-(4β→8)-epigallocatechin 3-*O*-gallate, 3-*O*-galloylepigallocatechin-(4β→8)-epigallocatechin 3-*O*-gallate, the hydrolysable tannin castalagin [127], 13-oxomyricanol [128], and proanthocyanidin [129]. In pharmacological investigations the plant has showed antioxidant [130-132], analgesic [132], anti-inflammatory [132-134], antimicrobial [135], chemopreventive [136], antiasthmatic [137], antidiarrheal, gut modulatory, bronchodilatory, vasodilatory [138], and anxiolytic properties [139].



16 **17**

Figure 6: Some compounds isolated from *Myrica nagi*.

***Olax scandens* Roxb.:** *O. scandens* (family Olacaceae) is a shrub widely distributed in Myanmar. As a traditional remedy, it has been used for curing fever, smallpox, measles, intestinal and liver diseases, and as a blood purifier [140]. In the few chemical investigations performed on *O. scandens* the presence of a saponin, olaxoside (**18**), has been reported [141]. The plant has displayed acute anti-inflammatory [141] and laxative activities [141-142], acute toxicity [142], and antimicrobial [143], antioxidant [144], and antipyretic effects [145].



18

Figure 7: Olaxoside isolated from *Olax scandens*.

***Pimpinella heyneana* Wall.:** *P. heyneana* (family Apiaceae) is a herbaceous plant rarely found in some parts of Myanmar, including the Chin State. It is used for the treatment of fever by Myanmar traditional healers; however, neither the constituents nor the biological/pharmacological properties have been investigated so far.

***Pterospermum semisagittatum* Buch. Ham. ex Roxb.:** *P. semisagittatum* (Sterculiaceae) grows in India, Sri Lanka, Bangladesh, Myanmar, Thailand, Cambodia, and Laos. Traditionally, the plant has been used to treat cough, skin diseases, and headache. In addition, *P. semisagittatum* has been used as an antihemorrhagic and antihypnotic remedy in folk medicine [11]. Phytochemical studies have revealed the presence of megastigmane glycosides, including (*Z*)-4-[3'-(β-D-glucopyranosyloxy) butylidene]-3,5,5-trimethyl-2-cyclohexen-1-one, (*E*)-4[3'-(β-D-glucopyranosyloxy) butylidene]-3,5,5-trimethyl-2-cyclohexen-l-one, (*E*)-4-hydroxy-4-[3'-(β-D-glucopyranosyloxy) butylidene]-3,5,5-trimethyl-2-cyclohexen-1-one [146], 10-hydroxy-4,7-megastigmadien-3-one-9-*O*-β-D-glucopyranoside, and 9-hydroxy-4,7-megastigmadien-3-one-10-*O*-β-D-glucopyranoside together with one neolignan, (7*S*,8*R*)-dihydrodehydrodiconiferyl alcohol-9'-*O*-β-D-glucopyranoside [147]. Biological studies were conducted on the antihyperglycemic activity of *P. semisagittatum* [146,148].

***Ruellia tuberosa* L.:** *R. tuberosa* (family Acanthaceae) is widely distributed in tropical areas of Asian countries. It is medicinally used as an antidote in Myanmar [15]. The abundant scientific literature about *R. tuberosa* has showed the presence of *n*-tritriacontane, tritriacontan-6-one, 5-hydroxytetratriacontan-9-one [149], cirsimaritin, cirsimarin, cirsiliol 4′-glucoside, sorbifolin, pedalitin, betulin, vanillic acid, indole-3-carboxaldehyde [150], apigenin-7-*O*-glucuronide, apigenin-7-*O*-glucoside, apigenin-7-*O*-

rutinoside, luteolin-7-*O*-glucoside [151], β-sitosterol glucoside, 3-hydroxy-1-(4-hydroxy-3-methoxyphenyl)-2-[4-(3-hydroxy-1-(*E*)-propenyl)-2-methoxyphenoxy] propyl-β-D-glucopyranoside, syringaresinol 4,4'-*O*-bis-β-D-glucopyranoside, (2*R*)-2-*O*-β-D-glucopyranosyl-2*H*-1,4-benzoxazin-3(4*H*)-one (HBOA-Glc, blepharin), syringin, roseoside, (+)-lyoniresinol 3α-*O*-β-D-glucopyranoside, pectolinargenin 7-*O*-β-D-glucopyranoside, cistanoside F, (2*R*)-2-*O*-β-D-glucopyranosyl-4-hydroxy-2H-1,4-benzoxazin-3(4H)-one (DIBOA-Glc), nepetin (6-methoxyluteolin) 7-*O*-β-D-glucopyranoside, demethoxycentaureidin 7-*O*-β-D-glucopyranoside [152], acteoside (verbascoside) [152-153], isoverbascoside, nuomioside, isonuomioside, forsythoside B, paucifloside, cassifolioside, hispidulin 7-*O*-β-D-glucuronopyranoside, comanthoside B, isocassifolioside (**19**), hispidulin 7-*O*-α-L-rhamnopyranosyl-(1'''→2'')-*O*-β-D-glucuronopyranoside, pectolinaringenin 7-*O*-α-L-rhamnopyranosyl-(1'''→2'')-*O*-β-D-glucuronopyranoside [153], 21-methyldammar-22-en-3β,18,27-triol (**20**) [154], campesterol, β-sitosterol, stigmasterol and lupeol [155]. Moronkola *et al*. studied the composition of volatile oils distilled from leaves, stems, roots, fruits, and flowers of *R. tuberosa* and reported that, among 109 identified constituents, (*E*)-phytol, tributylacetyl citrate, heptacosane, *m*-xylene, *p*-xylene, heptane, borneol, hexacosane, sexton, heneicosane, 2-methyl-2-pentanol, and 1-methyl-1-cyclopentanol predominate [156]. Many studies have verified that the extracts and compounds isolated from *R. tuberosa* exhibit a wide spectrum of pharmacological properties *in vitro* and *in vivo*, including cytotoxic [150, 157], antioxidant [158-161], anticholinesterase [161], antimicrobial [162-164], insecticidal [164], antifertility [165], anthelmintic [166], antihyperlipidaemic, hepatoprotective [167], and antidiabetic activities [167-168].

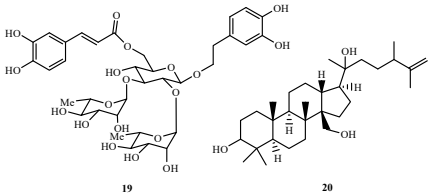


Figure 8: Some compounds isolated from *Ruellia tuberosa*.

***Smilax zeylanica* L.:** *S. zeylanica* (Smilacaceae) is a medicinal plant widely growing in many parts of Myanmar. The plant is useful for the treatment of leprosy, skin diseases, joint pain, inflammation, and as a blood purifier [17]. Although many researchers studied the pharmacological activities of this plant, the chemical constituents of *S. zeylanica* are still undetermined. The reported biological activities of *S. zeylanica* include antioxidant [169-173], antidiabetic [173-174], cytoprotective [175], hepatoprotective [172,176], anthelmintic, analgesic [177], antipyretic, anticonvulsant [178], and pesticidal effects [179].

***Stemona burkillii* Prain.:** *S. burkillii* (family Stemonaceae) is weakly climbing and produces stems up to 1 metre long from an underground tuber. Recently, the use of *S. burkillii* as a remedy against cancer has become very popular in Myanmar. Chemical investigations have resulted in the isolation of alkaloids, such as stemofoline (**21**), 2'-hydroxystemofoline, 11(*S*),12(*R*)-dihydrostemofoline, and stemoburkilline (**22**) [180,181]. According to Chanmahasathien *et al*., the isolated alkaloids, especially stemofoline, show potent growth inhibitory effects against cancer KB-V1 cells in synergy with cancer chemotherapeutic agents, such as vinblastine, paclitaxel and doxorubicin [182].

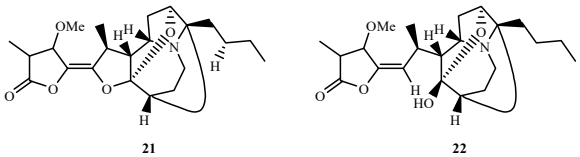


Figure 9: Some compounds isolated from *Stemona burkillii*.

***Tadehagi triquetrum* (L.) H. Ohashi.:** *T. triquetrum* (family Fabaceae) is a flowering plant which grows irregularly throughout all Asian countries. It is recommended for the treatments of cough, asthma, dysentery, bloated stomach, stomachache, fever, inflammation, vomiting, anal fistula, and urinary disorders, as documented in the Myanmar traditional medicine [89]. The ethanol extract of *T. triquetrum* contains triquetrumones A (**23**), B, and C, (*R*)-triquetrumone D (**24**), cyclokievitone, yukovanol, aromadendrin, kaempferol, astragalin, 2-*O*-methyl-L-chiro-inositol, galactitol, *p*-hydroxycinnamic acid, ursolic acid, betulinic acid, β-sitosterol, daucosterol, stigmasterol, stigmasta-5,22-dien-3-*O*-β-D-glucopyranoside, saccharose, docosanoic acid [183], triquetrumones E-H [184], tadehaginosin (**25**), and 3,4-dihydro-4-(4'-hydroxyphenyl)-5,7-dihydroxycoumarin [185]. Zhang *et al.*, in extensive investigations of this plant, has revealed the presence of various types of phenylpropanoid glucosides, including tadehaginoside (**26**), tadehaginoside A (**27**), and tadehaginoside B-I [186]. The compounds isolated from *T. triquetrum* were evaluated for anthelminthic [183], lipolysis [187], hypoglycemic [185-186], and antihepatotoxic activities [187].

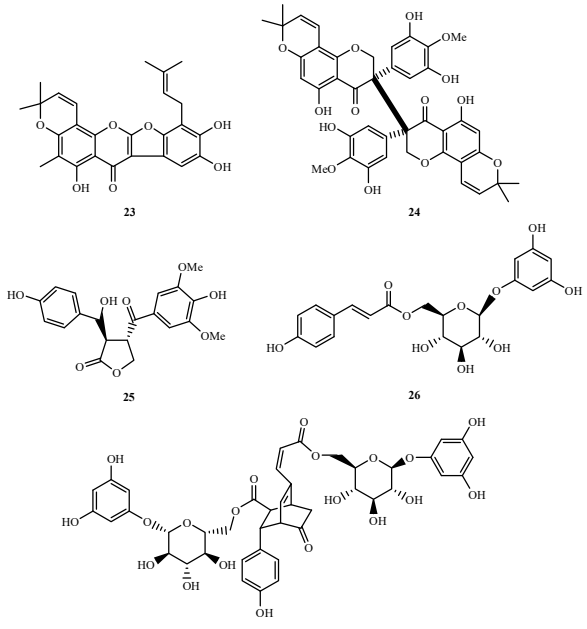


Figure 10: Some compounds isolated from *Tadehagi triquetrum.*

In conclusion, this is the first critical review about the ethnopharmacology of 20 medicinal plants which are widely distributed in the Chin State (Myanmar) and are commonly used in the local traditional medicine. We have reported the phytochemical constituents and the pharmacological/biological activities determined so far. Investigations about *Alangium chinense*, *Antidesma bunius*, *Gaultheria fragrantissima*, and *Millingtonia hortensis* have not definitely clarified the efficacy of these plants as traditional healing remedies. Analogously, although extracts and compounds isolated from *Leucas cephalotes* and *Ruellia tuberosa* have exhibited a wide spectrum of pharmacological activities *in vitro* as well as *in vivo*, the traditional use of these plants as an antidote still lacks scientific evidences. On the other hand, there are no scientific studies of the chemical and pharmacological properties

of *Anneslea fragrans*, *Ficus heterophylla*, and *Pimpinella heyneana* despite their ethnopharmacological uses have been documented. Limited work has been done about the chemical constituents of *Anemone obtusiloba*, *Leea macrophylla*, and *Olax scandens*. The biological activities of *Smilax zeylanica* have been investigated; however, the chemical constituents are still unknown. Instead, the chemical and pharmacological properties of *Croton oblongifolius* have extensively been investigated. Chemical and pharmacological analyses of *Embelia tsjeriam-cottam* and *Hydnocarpus kurzii* have mainly been focused on fruits and seeds; however, biological and phytochemical studies of other parts of these plants are still missing. *Myrica nagi* and *Pterospermum semisagittatum* are used in the Myanmar traditional medicine against many diseases, although such claims have yet no scientific evidences. *Stemona burkilli* is very well known in Myanmar for the treatment of cancer; therefore, this plant deserves further phytochemical and pharmacological investigations. Studies on *Tadehagi triquetrum* have revealed the presence of several bioactive compounds whose applications can further be exploited.

The collection of the ethnopharmacological information highlighted in this paper is the starting step of a long-term project aimed at the study of uninvestigated medicinal plants commonly used in the Chin State, Myanmar.

Acknowledgments – Our sincere thanks to Prof. Dr. Thet Naing Oo for the plant identification and Prof. Dr. Thet Khaing for the geographic information.

Table 1: Common Medicinal plants growing in the Chin State of Myanmar, their therapeutical applications, and biological/pharmacological activities.

No.	Scientific Name	Family	Part Used	Therapeutical applications	Reported biological/pharmacological activities
1.	*Alangium chinense* (Lour.) Harms	Alangiaceae	Leaves	Piles (hemorrhoids), sedative, anthelmintic [1], muscle relaxant and analgesic agent [2]	Neuritis inhibitory activities [4], antiviral activities [6-7], antioxidant activities [8], and cytotoxic activity [10]
2.	*Anemone obtusiloba* D.Don	Ranunculaceae	Barks, leaves, seeds	Spleen disorders, arthritis and as antispastic [1,11]	Antimicrobial activity [14]
3.	*Anneslea fragrans* Wall	Theaceae	Whole plant	Mouth and gallbladder diseases, asthma, blood purifier [15]	Antimalarial activity [16]
4.	*Antidesma bunius* (L.) Spreng	Euphorbiaceae	Leaves, barks, fruits	Antidote, syphilis, insect bites and stings [17]	Antioxidant [22-24], antidiabetic [25-29], antimicrobial [30], pesticide [31], and cytotoxic activities [32]
5.	*Croton oblongifolius* Roxb	Euphorbiaceae	Leaves, barks, roots	Dyspepsia, dysentery, hepatitis, pulmonary edema, abscess, and fever	Cytotoxic activity [35,39-40,43-47], antibacterial activity [50], and hepatoprotective activity [51]
6.	*Embelia tsjeriam-cottam* A. DC	Myrsinaceae	Fruits	vermifuge, carminative, stimulants, stomachic, chronic bronchitis, splenauxe, malaria and wound healing [11]	Anti-inflammatory [57], hepatoprotective [53,58], chemopreventive [53], cytotoxic, antimicrobial, antitubercular, antimycotic [54], and antioxidant activities [56]
7.	*Ficus heterophylla* L.f.	Moraceae	Leaves, barks	Flatulence, asthma and dysentery [17]	No report
8.	*Gaultheria fragrantissima* Wall.	Ericaceae	Leaves	Fever, headaches, inflammatory joint disorders, back pain, and used as antifebrile and diuretic [11]	Nematicidal [63], antioxidant [70], antifungal [71], and insecticidal properties [68,72]
9.	*Hydnocarpus kurzii* (King) Warb.	Flacourtiaceae	Seeds	Leprosy, skin diseases, intestinal worms, indigestion and blood poisoning [1]	Analgesic [75], antioxidant [76-77], antimicrobial [77], thrombolytic [78] and antihyperglycemic activities [79]
10.	*Leea macrophylla* Roxb.	Leeaceae	Roots	Ringworm, inflammation, wound, bleeding and pain [17]	Antioxidant [81-82,87], antimicrobial [82-83], wound healing [84], anti-inflammatory [85], anti-urolithiatic [86], neuroprotective [87], anti-nociceptive and cytotoxic activities [88]
11.	*Leucas cephalotes* Spreng.	Lamiaceae	Whole plant	Antidote, jaundice, inflammation, asthma, fever, cough, malaria, anemia and sexual weakness in male [11,89]	Anti-inflammatory [92,94-95], analgesic [94], antioxidant [96-97], antimicrobial [98-101], antifilarial [102], antifertility [103], antiplasmodial [104], hepatoprotective [105], and antidiabetes activities [93,106]
12.	*Millingtonia hortensis* L.f.	Bignoniaceae	Flowers, leaves and roots	Headache, heart palpitations, hypertension and diabetes [89]	Cytotoxicity [115-116], antioxidant, hepatotoxicity [117], antimicrobial activity [118-120], antimutagenic effect [121], and larvicidal activity [122-123]
13.	*Myrica nagi* Thunb.	Myricaceae	Barks	Running nose, cough, toothache, earache, asthma, diarrhoea, liver complaints, piles, epilepsy and wounds [17]	Antioxidant [130-132], analgesic [132], anti-inflammatory [132-134], antimicrobial [135], chemopreventive effect [136], antiasthmatic [137], antidiarrheal, gut modulatory, bronchodilatory, vasodilatory activities [138], and anxiolytic effect [139]
14.	*Olax scandens* Roxb.	Olacaceae	Leaves and roots	fever, smallpox, measles, intestinal and liver diseases, and blood purifier [140]	Anti-inflammatory activity [141], laxative activity [141-142], acute toxicity [142], antimicrobial activity [143], antioxidant [144], and antipyretic activity [145]
15.	*Pimpinella heyneana* Wall.	Apiaceae	Whole plant	Fever	No report
16.	*Pterospermum semisagittatum* Buch. Ham. ex Roxb.	Sterculiaceae	Whole plant	cough, skin diseases, headache and as antihemorrhagic and antihypnotic [11]	antihyperglycemic activity [146,148]
17.	*Ruellia tuberosa* L.	Acanthaceae	Whole plant	Antidote [15]	Cytotoxicity [150, 157], antioxidant [158-161], anticholinesterase [161], antimicrobial [162-164], insecticidal activity [164], anti-fertility [165], anthelmintic [166], antihyperlipidaemic, hepatoprotective [167], and antidiabetic activities [167-168].
18.	*Smilax zeylanica* L.	Smilacaceae	Leaves	Leprosy, skin diseases, joint pain, inflammation and purifying the blood [17]	Antioxidant [169-173], antidiabetic [173-174], cytoprotective [175], hepatoprotective [172,176], anthelmintics, analgesic [177], antipyretic, anticonvulsant [178], and pesticidal activities [179]
19.	*Stemona burkillii* Prain.	Stemonaceae	Tubers	Cancer	Cytotoxicity [182]
20.	*Tadehagi triquetrum* (L.) H.Ohashi	Fabaceae	Leaves and roots	cough, asthma, dysentery, bloated stomach, stomachache, fever, inflammation, vomiting, anal fistula and urinary disorders [89]	Anthelminthic [183], lipolysis [187], hypoglycemic [185-186], and antihepatotoxic activities [187]

References

[1] Khare CP. (**2007**) *Indian medicinal plants: An illustrated dictionary*. Springer-Verlag, New York.
[2] Chiang Su New Medical College. (**1978**) *Zhong-yao-dai-ci-dian (Dictionary of Chinese Crude Drugs)*. Shanghai Scientific Technologic Publisher, Shanghai, 24-26.
[3] Itoh A, Tanahashi T, Nagakura N. (**1997**) Two new phenolic glycosides from *Alangium chinense*. *Natural Medicines*, ***51***, 173-175.
[4] Itoh A, Tanahashi T, Nagakura N, Inoue K, Kuwajima H, Wu HX. (**2001**) Glycosides of benzyl and salicyl alcohols from *Alangium chinense*. *Chemical and Pharmaceutical Bulletin*, ***49***, 1343-1345.
[5] Itoh A, Tanahashi T, Ikejima (née Sato) S, Inoue M, Nagakura N, Inoue K, Kuwajima H, Wu HX. (**2000**) Five phenolic glycosides from *Alangium chinense*. *Journal of Natural Products*, ***63***, 95-98.

[6] Zhang Y, Liu YB, Li Y, Ma SG, Li L, Qu J, Zhang D, Chen XG, Jiang JD, Yu SS. (**2013**) Sesquiterpenes and alkaloids from the roots of *Alangium chinense*. *Journal of Natural Products*, ***76***, 1058-1063.

[7] Zhang Y, Liu YB, Li Y, Li L, Ma SG, Qu J, Jiang JD, Chen XG, Zhang D, Yu SS. (**2015**) Terpenoids from the roots of *Alangium chinense*. *Journal of Asian Natural Products Research*, ***17***, 1025-1038.

[8] Zhang Y, Liu YB, Li Y, Ma SG, Li L, Qu J, Zhang D, Jiang JD, Yu SS. (**2017**) Phenolic constituents from the roots of *Alangium chinense*. *Chinense Chemical Letters*, ***28***, 32-36.

[9] Zhang XH, Liu SS, Xuan LJ. (**2009**) Cyclopentenylglycines and other constituents from *Alangium chinense*. *Biochemical Systematics and Ecology*, ***37***, 214-217.

[10] Xing HH, Zhou K, Yang Y, Zhou L, Dong W, Wang YD, Ma HY, Zhou M, Ye YQ, Hu QF. (**2017**) A new cytotoxic alkaloid from roots of *Alangium chinense*. *China Journal of Chinese Materia Medica*, ***42***, 303-306.

[11] Ashin Nargasenarbivansa (**1973**) *Ashin Nargasein: Pohn-pya-say-abidan* (*Illustrated dictionary of traditional medicinal plants)*. ***4***, Pyimyanmar Press, Yangon.

[12] Masood M, Pandey A, Tiwari KP. (**1979**) Obtusilobinin and obtusilobin, two new triterpene saponins from *Anemone obtusiloba*. *Phytochemistry*, ***18***, 1539-1542.

[13] Tiwari KP, Masood M. (**1980**) Obtusilobicinin, a new saponin from *Anemone obtusiloba*. *Phytochemistry*, ***19***, 1244-1247.

[14] Kaushik V, Chaudhary G, Ahmad S, Saini V. (**2016**) Evaluation of antimicrobial potential of *Anemone obtusiloba* D. Don. *Der Pharmacia Lettre*, ***8***, 273-276.

[15] Ashin Nargasenarbivansa (**1968**) *Ashin Nargasein: Pohn-pya-say-abidan* (*Illustrated dictionary of traditional medicinal plants)*. ***2***, Mingalar Press, Yangon.

[16] Nguyen-Pouplin J, Tran H, Tran H, Phan TA, Dolecek C, Farrar J, Tran TH, Caron P, Bodo B, Grellier P. (**2007**) Antimalarial and cytotoxic activities of ethnopharmacologically selected medicinal plants from South Vietnam. *Journal of Ethnopharmacology*, ***109***, 417–427.

[17] Ashin Nargasenarbivansa (**1967**) *Ashin Nargasein: Pohn-pya-say-abidan* (*Illustrated dictionary of traditional medicinal plants)*. ***1***, Mingalar Press, Yangon.

[18] Hui WH, Sung ML. (**1968**) An examination of the Euphorbiaceae of Hong Kong. II. the occurrence of epitaraxerol and other triterpenoids. *Australian Journal of Chemistry*, ***21***, 2137-2140.

[19] Kassem MES, Hashim AN, Hassanein HM. (**2013**) Bioactivity of *Antidesma bunius* leaves (Euphorbiaceae) and their major phenolic constituents. *European Scientific Journal*, ***9***, 217-228.

[20] Trang DT, Huyen LT, Nhiem NX, Quang TH, Hang DTT, Yen PH, Tai BH, Anh HLT, Binh NQ, Minh CV, Kiem PV. (**2016**) Tirucallane glycoside from the leaves of *Antidesma bunius* and inhibitory NO production in BV2 cells and RAW264.7 Macrophages. *Natural Product Communications*, ***11***, 935-937.

[21] Butkhup L, Samappito S. (**2008**) An analysis on flavonoids contents in Mao Luang fruits of fifteen cultivars (*Antidesma bunius*), grown in Northeast Thailand. *Pakistan Journal of Biological Sciences*, ***11***, 996-1002.

[22] Barcelo JM, Nullar ARM, Caranto JKP, Gatchallan AM, Aquino IJB. (**2016**) Antioxidant and antimutagenic activities of ripe Bignay (*Antidesma bunius*) crude fruit extract. *Philippine e-Journal for Applied Research and Development*, ***6***, 32-43.

[23] Chaikham P, Baipong S. (**2016**) Comparative effects of high hydrostatic pressure and thermal processing on physicochemical properties and bioactive components of Mao Luang (*Antidesma bunius* Linn.) juice. *Chiang Mai Journal of Science*, ***43***, 851-862.

[24] Islary A, Sarmah J, Basumatary S. (**2017**) Nutritional value, phytochemicals and antioxidant properties of two wild edible fruits (*Eugenia operculata* Roxb. and *Antidesma bunius* L.) from Assam, North-East India. *Mediterranean Journal of Nutrition and Metabolism*, ***10***, 29-40.

[25] Elya B, Malik A, Mahanani PIS, Loranze B. (**2012**) Antidiabetic activity test by inhibition of α-glucosidase and phytochemical screening from the most active fraction of Buni (*Antidesma bunius* L.) stem barks and leaves. *International Journal of Pharm Tech Research*, ***4***, 1667-1671.

[26] Quiming N, Asis JL, Nicolas M, Versoza D, Alvarez MR. (**2016**) In *vitro* α-glucosidase inhibition and antioxidant activities of partially purified *Antidesma bunius* fruit and *Gynura nepalensis* leaf extracts. *Journal of Applied Pharmaceutical Science*, ***6***, 97-101.

[27] El-tantawy WH, Soliman ND, El-naggar D, Shafei A. (**2015**) Investigation of antidiabetic action of *Antidesma bunius* extract in type 1 diabetes. *Archieves of Physiology and Biochemistry*, ***121***, 116-122.

[28] Quiming N, Dayanan JN, Nicolas M, Verzosa D, Alvarez MR. (**2017**) Hypoglycemic activities of chromatographic fractions of *Antidesma bunius* fruit ethanolic extract on Alloxan-induced hyperglycemic Balb/C mice. *Journal of Applied Pharmaceutical Science*, ***7***, 120-123.

[29] Chowtivannakul P, Srichaikul B, Talubmook C. (**2016**) Hypoglycemic and hypolipidemic effects of seed extract from *Antidesma bunius* (L.) Spreng in Streptozotocin-induced diabetic rats. *Pakistan Journal of Biological Sciences*, ***19***, 211-218.

[30] Lizardo RCM, Mabesa LB, Dizon EI, Aquino NA. (**2015**) Functional and antimicrobial properties of bignay [*Antidesma bunius* (L.) Spreng.] extract and its potential as natural preservative in a baked product. *International Food Research Journal*, ***22***, 88-95.

[31] Belmi RM, Giron J, Tansengco ML. (**2014**) *Antidesma bunius* (Bignay) fruit extract as an organic pesticide against *Epilachna spp*. *Journal of Asian Scientific Research*, ***4***, 320-327.

[32] Micor JRL, Deocaris CC, Mojica ERE. (**2005**) Biological activity of Bignay [*Antidesma bunius* (L.) Spreng] crude extract in Artemia salina. *Journal of Medical Sciences*, ***5***, 195-198.

[33] Aiyar VN, Seshadri TR. (**1970**) Components of *Croton oblongifolius*- III constitution of oblongifolic acid. *Tetrahedron*, ***26***, 5275-5279.

[34] Aiyar VN, Seshadri TR. (**1972**) 11-dehydro (-)-hardwickic acid from *Croton oblongifolius*. *Phytochemistry*, ***11***, 1473-1476.

[35] Roengsumran S, Pornpakakul S, Muangsin N, Sangvanich P, Nhujak T, Singtothong P, Chaichit N, Puthong S, Petsom A. (**2004**) New halimane diterpenoids from *Croton oblongifolius*. *Planta Medica*, ***70***, 87-89.

[36] Rao PS, Sachdev GP, Seshadri TR, Singh HB. (**1968**) Isolation and constitution of Oblongifoliol, a new diterpene of *Croton oblongifolius*. *Tetrahedron Letters*, ***45***, 4685-4688.

[37] Roengsumran S, Petsom A, Sommit D, Vilaivan T. (**1999**) Labdane diterpenoids from *Croton oblongifolius*. *Phytochemistry*, ***50***, 449-453.

[38] Roengsumran S, Jaiboon N, Chaichit N, Sommit D, Pattamadilok D, Chaichantipyuth C, Petsom A. (**2002**) Hydrogen bonding in labdane diterpenoids, labda-7,12(*E*),14-triene-17-oic acid and labda-12(*Z*),14,17-triene-18-oic acid. *Journal of Chemical Crystallography*, ***32***, 511-517.

[39] Roengsumran S, Petsom A, Kuptiyanuwat N, Vilaivan T, Ngamrojnavanich N, Chaichantipyuth C, Phuthong S. (**2001**) Cytotoxic labdane diterpenoids from *Croton oblongifolius*. *Phytochemistry*, ***56***, 103-107.

[40] Roengsumran S, Pata P,Ruengraweewat N, Tummatorn J, Pornpakakul S, Sangvanich P, Puthong S, Petsom A. (**2009**) New cleistanthane diterpenoids and 3,4-*seco*-cleistanthane diterpenoids from *Croton oblongifolius*. *Chemistry of Natural Compounds*, ***45***, 641-646.

[41] Suwancharoen S, Chonvanich O, Roengsumran S, Pornpakakul S. (**2012**) *seco*-kaurane skeleton diterpenoids from *Croton oblongifolius*. *Chemistry of Natural Compounds*, ***48***, 583-586.

[42] Roengsumran S, Achayindee S, Petsom A, Pudhom K, Singtothong P, Surachetapan C, Vilaivan T. (**1998**) Two new cembranoids from *Croton oblongifolius*. *Journal of Natural Products*, ***61***, 652-654.

[43] Roengsumran S, Singtothong P, Pudhom K, Ngamrochanavanich N, Petsom A, Chaichantipyuth C. (**1999**) Neocrotocembranal from *Croton oblongifolius*. *Journal of Natural Products*, ***62***, 1163-1164.

[44] Pudhom K, Vilaivan T, Ngamrojanavanich N, Dechangvipart S, Sommit D, Petsom A, Roengsumran S. (**2007**) Furanocembranoids from the stem bark of *Croton oblongifolius*. *Journal of Natural Products*, ***70***, 659-661.

[45] Pudhom K, Sommit D. (**2011**) Clerodane diterpenoids and a trisubstituted furan from *Croton oblongifolius*. *Phytochemistry Letters*, ***4***, 147-150.

[46] Youngsa-ad W, Ngamrojanavanich N, Mahidol C, Ruchirawat S, Prawat H, Kittakoop P. (**2007**) Diterpenoids from the roots of *Croton oblongifolius*. *Planta Medica*, ***73***, 1491-1494.

[47] Roengsumran S, Musikul K, Petsom A, Vilaivan T, Sangvanich P, Pornpakakul S, Puthong S, Chaichantipyuth C, Jaiboon N, Chaichit N. (**2002**) Croblongifolin, a new anticancer clerodane from *Croton oblongifolius*. *Planta Medica*, ***68***, 274-277.

[48] Takeshige Y, Kawakami S, Matsunami K, Otsuka H, Lhieochaiphant D, Lhieochaiphant S. (**2012**) Oblongionosides A-F, megastigmane glycosides from the leaves of *Croton oblongifolius* Roxburgh. *Phytochemistry*, ***80***, 132-136.

[49] Ahmed B, Alam T, Najam L, Khan SA. (**2016**) Oblongiside: a new steroidal glycoside from aerial parts of *Croton oblongifolius* Roxb. *Asian Journal of Chemistry*, ***28***, 517-519.

[50] Athikomkulchai S, Tadtong S, Ruangrungsi N, Hongratanaworakit T. (**2015**) Chemical composition of the essential oils from *Croton oblongifolius* and its antibacterial activity against *Propionibacterium acnes*. *Natural Product Communications*, ***10***, 1459-1460.

[51] Ahmed B, Alam T, Varshney M, Khan SA. (**2002**) Hepatoprotective activity of two plants belonging to the Apiaceae and the Euphorbiaceae family. *Journal of Ethnopharmacology*, ***79***, 313-316.

[52] Raja SS, Unnikrishnan KP, Ravindran PN, Balachandran I. (**2005**) Determination of embelin in *Embelia ribes* and *Embelia tsjeriam-cottam* by HPLC. *Indian Journal of Pharmaceutical Sciences*, ***67***, 734-736.

[53] Poojari R, Gupta S, Maru G, Khade B, Bhagwat S. (**2010**) Chemopreventive and hepatoprotective effects of embelin on N-nitrosodiethylamine and carbon tetrachloride induced preneoplasia and toxicity in rat liver. *Asian Pacific Journal of Cancer Prevention*, ***11***, 1015-1020.

[54] Poojari R. (**2011**) Phytochemical fingerprinting, cytotoxic, antimicrobial, antitubercular, antimycotic potentials of *Sida rhombifolia* subsp. *retusa* and *Embelia tsjeriam-cottam*. *Asia Pacific Journal of Life Sciences*, ***4***, 201-214.

[55] Mohaptra M, Basak UC. (**2014**) Assessment of embelin in fruits of *Embelia tsjeriam-cottam* A. DC., a threatened medicinal plant of Odisha, India. *American Journal of PharmTech Research*, ***4***, 212-221.

[56] Mohapatra M, Basak UC. (**2017**) Quantitization of antioxidant potency in various plant parts of *Embelia tsjeriam-cottam*, an important medicinal plant. *Journal of Medicinal Plants Studies*, ***5***, 241-249.

[57] Vite MH, Nangude SL, Gorte SM. (**2011**) Anti-inflammatory effect of ethanolic extract of *Embelia tsjeriam cottam*. *International Journal of Pharmacy and Pharmaceutical Sciences*, ***3***, 101-102.

[58] Sambrekar SN, Patil PA, Kangralkar VA. (**2010**) Protective effect of *Embelia tsjeriam-cottam* fruit extracts on isoniazid induced hepatotoxicity in Wistar rats. *International Journal of Pharmaceutical Sciences Review and Research*, ***4***, 136-139.

[59] Murthy KS, Babu MR. (**1972**) Chemical investigation of the leaves of *Gaultheria fragrantissima* Wall. *Indian Journal of Pharmacy*, ***125***, 34-38.

[60] Ma XJ, Zhao L, Han ZT, Zheng JH, Chen XZ. (**2002**) Comparison of the contents of lignans in 5 medicinal plants of *Gaultheia* by HPLC. *Journal of Plant Resources and Environment*, ***11***, 61-62.

[61] Cong F, Joshi KR, Devkota HP, Watanabe T, Yahara S. (**2015**) Dhasingreoside: new flavonoid from the stems and leaves of *Gaultheria fragrantissima*. *Natural Product Research*, ***29***, 1442-1448.

[62] Towers GHN, Tse A, Maass WSG. (**1966**) Phenolic acids and phenolic glycosides of *Gaultheria* species. *Phytochemistry*, ***5***, 677-681.

[63] Kim J, Seo SM, Park IK. (**2011**) Nematicidal activity of plant essential oils and components from *Gaultheria fragrantissima* and *Zanthoxylum alatum* against the pine wood nematode, *Bursaphelenchus xylophilus*. *Nematology*, ***13***, 87-93.

[64] Josi(Mulmi) S, Subedi PC. (**2013**) Phytochemical and biological studies on essential oil and leaf extracts of *Gaultheria fragrantissima* Wall. *Nepal Journal of Science and Technology*, ***14***, 59-64.

[65] Kim J, Jang M, Shin E, Kim J, Lee SH, Park CG. (**2016**) Fumigant and contact toxicity of 22 wooden essential oils and their major components against *Drosophila suzukii* (Diptera: Drosophilidae). *Pesticide Biochemistry and Physiology*, ***133***, 35-43.

[66] Staub PO, Schiestl FP, Leonti M, Weckerle CS. (**2011**) Chemical analysis of incense somkes used in Shaxi, Southwest China: a novel methodological approach in ethnobotany. *Journal of Ethnopharmacology*, ***138***, 212-218.

[67] Bantawa P, Da Silva JAT, Ghosh SK, Mondal TK. (**2011**) Determination of essential oil contents and micropropagation of *Gaultheria fragrantissima*, an endangered woody aromatic plant of India. *Journal of Horticultural Science & Biotechnology*, ***86***, 479-485.

[68] Park CG, Shin E, Kim J. (**2016**) Insecticidal activities of essential oils, *Gaultheria fragrantissima* and *Illicium verum*, their components and analogs against *Callosobruchus chinensis* adults. *Journal of Asia-Pacific Entomology*, ***19***, 269-273.

[69] Adhikary SR, Bashyal BP. (**1985**) Aromatic plants of Napal-part IV. essential oil from *Gaultheria fragrantissima* Wall. *Journal of Nepal Pharmaceutical Association*, ***12***, 9-19.

[70] Shanmugarajan TS, Niladri M, Somasundaram I, Prithwish N, Patel S, Nazeer Ahamed KFH. (**2009**) Antioxidant potential of *Gaultheria fragrantissima* against adjuvant induced arthritis in Wistar rats. *Pharmaceutical Biology*, ***47***, 414-421.

[71] Shrestha AK, Tiwari RD. (**2009**) Antifungal activity of crude extracts of some medicinal plants against *Fusarium solani* (Mart.) Sacc.. *Ecoprint*, ***16***, 75-78.

[72] Paul D, Choudhury M. (**2016**) Larvicidal and antifeedant activity of some indigenous plants of Meghalaya against 4th instar *Helicoverpa armigera* (Hübner) larvae. *Journal of Crop Protection*, ***5***, 447-460.

[73] Cole HI, Cardoso H. (**1939**) Analysis of chaulmoogra oils. III. *Hydnocarpus wightiana* oil. *Journal of the American Chemical Society*, ***61***, 2351-2353

[74] Sengupta A, Gupta JK, Dutta J, Ghosh A. (**1973**) The component fatty acids of Chaulmoogra oil. *Journal of the Science of Food and Agriculture*, ***24***, 699-674.

[75] Sikder MAA, Rashid RB, Islam F, Hossian AKMN, Siddique AB, Kabir S, Haque MR, Rahman MS, Rashid MA. (**2013**) Screening of ten medicinal plants of Bangladesh for analgesic activity of Swiss-albino mice. *Oriental Pharmacy and Experimental Medicine*, ***13***, 327-332.

[76] Siddique AB, Islam R, Sikder MAA, Rashid RB, Hossian AKMN, Rashid MA. (**2014**) *In vitro* bioactivities of three reputed medicinal plants of Bangladesh. *Bangladesh Pharamaceutical Journal*, ***17***, 147-150.

[77] Sarbadhikary SB, Bhowmik S, Datta BK, Mandal NC. (**2015**) Antimicrobial and antioxidant activity of leaf extracts of two indigenous angiosperm species of Tripura. *International Journal of Current Microbiology and Applied Sciences*, ***4***, 643-655.

[78] Sikder MAA, Siddique AB, Hossian AKMN, Miah MK, Kaisar MA, Rashid MA. (**2011**) Evaluation of thrombolytic activity of four Bangladeshi medicinal plants, as a possible renewable source for thrombolytic compounds. *Journal of Pharmacy and Nutrition Sciences*, ***1***, 4-8.

[79] Islam E, Kudrot-e-azam M, Rahman MA, Rahman S, Rahmatullah M. (**2015**) Oral glucose tolerance and preliminary phytochemical and toxicity studies on *Hydnocarpus kurzii* bark methanolic extract. *Journal of Chemical and Pharamaceutical Research*, ***7***, 640-643.

[80] Mahmud ZA, Bachar SC, Hasan CM, Emran TB, Qais N, Uddin MMN. (**2017**) Phytochemical investigations and antioxidant potential of roots of *Leea macrophylla* (Roxb.). *BMC Res Notes*, ***10***:245, DOI: 10.1186/s13104-017-2503-2.

[81] Akhter S, Rahman MA, Aklima J, Hasan MR, Chowdhury JMKH. (**2015**) Antioxidative role of Hatikana (*Leea macrophylla* Roxb.) partially improves the hepatic damage induced by CCl_4 in Wistar albino rats. *BioMed Research International*, DOI: 10.1155/2015/356729.

[82] Joshi A, Prasad SK, Joshi VK, Hemalatha S. (**2016**) Phytochemical standardization, antioxidant, and antibacterial evaluations of *Leea macrophylla*: a wild edible plant. *Journal of Food and Drug Analysis*, ***24***, 324-331.

[83] Islam MB, Sarkar MMH, Shafique MZ, Jalil MA, Haque MZ, Amin R. (**2013**) Phytochemical screening and anti-microbial activity studies on *Leea macrophylla* seed extracts. *Journal of Scientific Research*, ***5***, 399-405.

[84] Joshi A, Joshi VK, Pandey D, Hemalatha S. (**2016**) Systematic investigation of ethanolic extract from *Leea macrophylla*: implications in wound healing. *Journal of Ethnopharmacology*, ***191***, 95-106.

[85] Dewanjee S, Dua TK, Sahu R. (**2013**) Potential anti-inflammatory effect of *Leea macrophylla* Roxb. leaves: a wild edible plant. *Food and Chemical Toxicology*, ***59***, 514-520.

[86] Nizami AN, Rahman MA, Ahmed NU, Islam MS. (**2012**) Whole *Leea macrophylla* ethanolic extract normalizes kidney deposits and recovers renal impairments in an ethylene glycol-induced urolithiasis model of rats. *Asian Pacific Journal of Tropical Medicine*, ***5***, 533-538.

[87] Ferdousy S, Rahman MA, Al-Amin MM, Aklima J, Chowdhury JMKH. (**2016**) Antioxidative and neuroprotective effects of *Leea macrophylla* methanol root extracts on diazepam-induced memory impairment in amnesic Wistar albino rat. *Clinical Phytoscience*, ***2***:17, DOI: 10.1186/s40816-016-0031-6.

[88] Mahmud ZA, Bachar SC, Qais N. **(2011)** Evaluation of anti-nociceptive activity and brine shrimp lethality bioassay of roots of *Leea macrophylla* Roxb.. *International Journal of Pharmaceutical Sciences and Research*, ***2***, 3230-3234.

[89] DeFilipps RA, Krupnick GA. **(2018)** The medicinal plants of Myanmar. *Phytokeys*, ***102***, 1-341, DOI:10.3897/phytokeys.102.24380.

[90] Miyaichi Y, Segawa A, Tomimori T. (**2006**) Studies on Nepalese crude drugs. XXIX.[1)] chemical constituents of Dronapuspi, the whole herb of *Leucas cephalotes* Spreng.. *Chemical and Pharmaceutical Bulletin*, ***54***, 1370-1379.

[91] Bahadur KD, Sen AB. (**1969**) Chemical examination of *Leucas cephalotes*. *Quarterly Journal of Crude Drug Research*, ***9***, 1453-1454.

[92] Patel NK, Khan MS, Bhutani KK. (**2015**) Investigation on *Leucas cephalotes* (Roth.) Spreng. for inbihition of LPS-induced pro-inflammatory mediators in murine macrophages and in rat model. *EXCLI Journal*, ***14***, 508-516.

[93] Verma A, Kumar A, Upreti DK, Pande V, Pal M. (**2017**) Fatty acid profiling and *in vitro* antihyperglycemic effect of *Leucas cephalotes* (Roth) Spreng via carbohydrate hydrolysing enzyme inhibition. *Pharmacognosy Magazine*, ***13***, 22-25

[94] Baburao B, Reddy ARN, Kiran G, Reddy YN, Mohan GK. (**2010**) Antioxidant, analgesic and anti-inflammatory activities of *Leucas cephalotes* (Roxb.ex Roth) Spreng. *Brazilian Journal of Pharmaceutical Sciences*, ***46***, 525-529.

[95] Patel NK, Pulipaka S, Dubey SP, Bhutani KK. (**2014**) Pro-inflammatory cytokines and nitric oxide inhibitory constituents from *Cassia occidentalis* roots. *Natural Product Communications*, ***9***, 661-664.

[96] Rao BB, Kumar SV, Rao BR, Mohan GK. (**2014**) Study of antioxidant activity of different fractions of *Leucas cephalotes* (Roxb.ex Roth) Spreng. *World Journal of Pharmaceutical Research*, ***3***, 953-958.

[97] Shahwar D, Naz M, Raza MA, Ara G, Yasmeen A, Saeed A, Bokhari S, Ajaib M, Ahmad N. (**2012**) Acetylcholine esterase inhibitory potential and antioxidant activity of various extracts of *Leucas cephalotes* and *Juglans regia* L. *Asian Journal of Chemistry*, ***24***, 3151-3154.

[98] Antariksh K, Kumar PC, Kumar TA, Pradeep S. (**2010**) Phytochemical investigation and antimicrobial activity of *Leucas cephalotes* Roth. Spreng whole herb. *Der Pharmacia Lettre*, ***2***, 284-296.

[99] Kumar D, Kumar V, Jangra P, Singh S. (**2016**) *Leucas cephalotes* (Spreng): photochemical investigation and antimicrobial activity via cylinder-plate method or cup-plate method. *International Journal of Pharmaceutical Science and Research*, ***1***, 28-32.

[100] Khan AV, Ahmed QU, Khan AA, Shukla I. (**2014**) *In vitro* antibacterial efficacy of *Leucas cephalotes* (Roth) Spreng. (Lamiaceae) against some gram positive and gram negative human pathogens. *International Journal of Agricultural and Food Research*, ***3***, 1-9.

[101] Madhukiran BL, Vijaya LK, Uma MDP. (**2002**) Antibacterial properties of *Leucas cephalotes* (Roth) Spreng. Leaf. *Ancient Science of Life*, ***21***, 244-247.

[102] Qamaruddin, Parveen N, Khan NU, Singhal KC. (**2002**) *In vitro* antifilarial potential of the flower and stem extracts of *Leucas cephalotes* on cattle filarial parasite *Setaria cervi*. *Journal of Natural Remedies*, ***2***, 155-163.

[103] Bhoria R, Kainsa S, Chaudhary M. (**2013**) Antifertility activity of chloroform and alcoholic flower extracts of *Leucas cephalotes* (Roth.) Spreng. in albino rats. *International Journal of Drug Development and Research*, ***5***, 168-173.

[104] Dua VK, Verma G, Agarwal DD, Kaiser M, Brun R. (**2011**) Antiprotozoal activities of traditional medicinal plants from the Garhwal region of North West Himalaya, India. *Journal of Ethnopharmacology*, ***136***, 123-128.

[105] Bais B, Saiju P. (**2014**) Ameliorative effect of *Leucas cephalotes* extract on isoniazid and rifampicin induced hepatotoxicity. *Asian Pacific Journal of Tropical Biomedicine*, ***4***, S633-S638.

[106] Bavarva JH, Narasimhacharya AVRL. (**2010**) *Leucas cephalotes* regulates carbohydrate and lipid metabolism and improves antioxidant status in IDDM and NIDDM rats. *Journal of Ethnopharmacology*, ***127***, 98-102.

[107] Sharma RC, Zaman A, Kidwai AR. (**1968**) Chemical examination of *Millingtonia hortensis*. *Phytochemistry*, ***7***, 1891-1892.

[108] Subramanian SS, Nagarajan S, Solochana N. (**1971**) Flavonoids of *Millingtonia hortensis*. *Current Science*, ***40***, 194-195.

[109] Anulakanapakorn K, Bunyapraphatsara N, Satayavivad J. (**1987**) Phytochemical and pharmacological studies of the flowers of *Millingtonia hortensis* Linn. F. *Journal of the Science Society of Thailand*, ***13***, 71-83.

[110] Singh P, Prakash L, Joshi KC. (**1972**) Lapachol and other constituents from the Bignoniaceae. *Phytochemistry*, ***11***, 1498.

[111] Naowsaran K, Skelton BW, Tooptakong U, Tuntiwachwuttikul P, White AH. (**1989**) Constituents of *Millingtonia hortensis*: isolation and crystal structure of *trans*-1-(2'-hydroxyethyl)cyclohexane-1,4-diol. *Australian Journal of Chemistry*, ***42***, 1397-1341.

[112] Hase T, Ohtani K, Kasai R, Yamasaki K, Picheansoonthon C. (**1995**) Revised structure for hortensin, a flavonoid from *Millingtonia hortensis*. *Phytochemistry*, ***40***, 287-290.

[113] Hase T, Ohtani K, Kasai R, Yamasaki K, Picheansoonthon C. (**1996**) Millingtonine, an unusual glucosidal alkaloid from *Millingtonia hortensis*. *Phytochemistry*, ***41***, 317-321.

[114] Hase T, Kawamoto Y, Ohtani K, Kasai R, Yamasaki K, Picheansoonthon C. (**1995**) Cyclohexylethanoids and related glucosides from *Millingtonia hortensis*. *Phytochemistry*, ***39***, 235-241.

[115] Tansuwanwong S, Hiroyuki Y, Kohzoh I, Vinitketkumnuen U. (**2006**) Induction of apoptosis in RKO cancer cells line by an aqueous extract of *Millingtonia hortensis*. *Asian Pacific Journal of Cancer Prevention*, ***7***, 641-644.

[116] Tansuwanwong S, Hiroyuki Y, Imai K, Vinitketkumnuen U. (**2009**) Antiproliferation and apoptosis on RKO colon cancer by *Millingtonia hortensis*. *Plant Foods for Human Nutrition*, ***64***, 11-17.

[117] Babitha S, Banji D, Banji OJF. (**2012**) Antioxidant and hepatoprotective effects of flower extract of *Millingtonia hortensis* Linn. on carbon tetrachloride induced hepatotoxicity. *Journal of Pharmacy and Bioallied Sciences*, ***4***, 307-312.

[118] Jetty A, Iyengar DS. (**2000**) Antimicrobial activity of *Millingtonia hortensis* leaf extract. *Pharmaceutical Biology*, ***38***, 157-160.

[119] Sittiwet C. (**2009**) Anti-microbial activities of *Millingtonia hortensis* Linn. flowers essential oil. *Journal of Pharmacology and Toxicology*, ***4***, 41-44.

[120] Sharma M, Puri S, Sharma PD. (**2007**) Antifungal activity of *Millingtonia hortensis*. *Indian Journal of Pharmaceutical Sciences*, ***69***, 599-601.

[121] Chulasiri M, Bunyapraphatsara N, Moongkarndi P. (**1992**) Mutagenicity and antimutagenicity of hispidulin and hortensin, the flavonoids from *Millingtonia hortensis* L. *Environmental and Molecular Mutagenesis*, ***20***, 307-312.

[122] Kaushik R, Saini P. (**2008**) Larvicidal activity of leaf extract of *Millingtonia hortensis* (Family: Bignoniaceae) against *Anopheles stephensi*, *Culex quinquefasciatus* and *Aedes aegypti*. *Journal of Vector Borne Diseases*, ***45***, 66-69.

[123] Kaushik R, Saini P. (**2009**) Screening of some semi-arid region plants for larvicidal activity against *Aedes aegypti* mosquitoes. *Journal of Vector Borne Diseases*, ***46***, 244-246.

[124] Xrishnamoorthy V, Krishnaswamy NR, Seshadri TR. (**1963**) Myriconol from the stem bark of *Myrica nagi*. *Current Science*, ***32***, 16-17.

[125] Begley MJ, Campbell RVM, Crombie L, Tuck B, Whiting DA. (**1971**) Constitution and absolute configuration of meta,meta-bridged, strained biphenyls from *Myrica nagi*; X-ray analysis of 16-bromomyricanol. *Journal of the Chemical Society C: Organic*, ***0***, 3634-3642.

[126] Campbell RVM, Crombie L, Tuck B, Whiting DA. (**1970**) Isolation and structure of new meta-bridged biphenyls from *Myrica nagi*. *Chemical communications*, 1206-1207.

[127] Sun D, Zhao Z, Wong H, Foo LY. (**1988**) Tannins and other phenolics from *Myrica esculenta* bark. *Phytochemistry*, ***27***, 579-583.

[128] Malterud KE, Anthonsen T. (**1980**) 13-oxomyricanol, a new [7.0]-metacyclophane from *Myrica nagi*. *Phytochemistry*, ***19***, 705-707.

[129] Krishnamoorthy V, Seshadri TR. (**1966**) A new proanthocyanidin from the stem bark of *Myrica nagi* Thumb. *Tetrahedron*, ***22***, 2367-2371.

[130] Goyal AK, Mishra T, Bhattacharya M, Kar P, Sen A. (**2013**) Evaluation of phytochemical constituents and antioxidant activity of selected actinorhizal fruits growing in the forests of Northeast India. *Journal of Biosciences*, ***38***, 797-803.

[131] Rana RK, Patel RK. (**2014**) Antioxidant activity of bark of *Myrica nagi*. *International Journal of Pharmaceutical Sciences Review and Research*, ***28***, 99-101.

[132] Middha SK, Usha T, Babu D, Misra AK, Lokesh P, Goyal AK. (**2016**) Evaluation of antioxidative, analgesic and anti-inflammatory activities of methanolic extract of *Myrica nagi* leaves - an animal model approach. *Symbiosis*, ***70***, 179-184.

[133] Patel T, Dudhpejiya A, Sheath N. (**2011**) Anti inflammatory activity of *Myrica nagi* Linn. Bark. *Ancient Science of Life*, ***30***, 100-103.

[134] Middha SK, Goyal AK, Bhardwaj A, Kamal R, Lokesh P, Prashanth HP, Wadhwa G, Usha T. (**2016**) In silico exploration of cyclooxygenase inhibitory activity of natural compounds found in *Myrica nagi* using LC-MS. *Symbiosis*, ***70***, 169–178.

[135] Saklani S, Chandra S, Mishra AP, Badoni PP. (**2012**) Nutritional evaluation, antimicrobial activity and phytochemical screening of wild edible fruit of *Myrica nagi* pulp. *International Journal of Pharmacy and Pharmaceutical Sciences*, ***4***, 407-411.

[136] Alam A, Iqbal M, Saleem M, Ahmed SU, Sultana S. (**2000**) *Myrica nagi* attenuates cumene hydroperoxide-induced cutaneous oxidative stress and toxicity in Swiss albino mice. *Pharmacology & Toxicology*, ***86***, 209-214.

[137] Rana RK, Patel RK. (**2016**) Pharmacological evaluation of antiasthmatic activity of *Myrica nagi* bark extracts. *Anti-Inflammatory & Anti-Allergy Agents in Medicinal Chemistry*, ***15***, 145-152.

[138] Aleem A, Janbaz KH, Mehmood MH, Bashir S, Jawed F, Rehman NU, Gilani AH. (**2015**) Pharmacological studies on antidiarrheal, gut modulatory, bronchodilatory and vasodilatory activities of *Myrica nagi*. *International Journal of Pharmacology*, ***11***, 888-898.

[139] Khan MY, Sagrawat H, Upmanyu N, Siddique S. (**2008**) Anxiolytic properties of *Myrica nagi* bark extract. *Pharmaceutical Biology*, ***46***, 757-761.

[140] Ashin Nargasenarbivansa (**1971**) *Ashin Nargasein: Pohn-pya-say-abidan* (*Illustrated dictionary of traditional medicinal plants)*. ***3***, Pyimyanmar Press, Yangon

[141] Forgacs P, Provost J. (**1981**) Olaxoside, a saponin from *Olax andronensis*, *Olax glabriflora* and *Olax psittacorum*. *Phytochemistry*, ***20***, 1689-1691.

[142] Naik R, Acharya R, Nariya MB, Borkar SD. (**2015**) Evaluation of acute toxicity and intestinal transit time of *Olax scandens* Roxb. leaves. *Ayu*, ***36***, 437-439.

[143] Owk AK, Lagudu MN. (**2016**) Evaluation of antimicrobial activity and phytochemicals in *Olax scandens* Roxb. roots. *Pharma Science Monitor*, ***7***, 232-239.

[144] Naik R, Borkar SD, Acharya RN, Shukla VJ. (**2015**) Evaluation of phytochemical content, nutritional value and antioxidant activity of *Olax scandens* (Roxb) leaves. *International Ayurvedic Medical Journal*, ***3***. 702-709.

[145] Naik R, Borkar SD, Acharya RN, Nariya M. (**2015**) Evaluation of antipyretic activity of *Olax scandens* (Roxb.) Stem Bark. *Research & Reviews: Journal of Pharmacology*, ***5***, 15–18.

[146] Khan SH, Mosihuzzaman M, Nahar N, Rashid MA, Rokeya B, Ali L, Khan A. (**2003**) Three megastimane glycosides from the leaves of *Pterospermum semisagittatum*. *Pharmaceutical Biology*, ***41***, 512-515.

[147] Khan MSH, Nahar N, Mosihuzzaman M, Rashid MA. (**2005**) Neolignan and megastigmane glycosides from the leaves of *Pterospermum semisagittatum*. *Pharmazie*, ***60***, 72-74.

[148] Mamun MIR, Rokeya B, Chowdhury NS, Muniruzzaman M, Nahar N, Ahmed MU, Mosihuzzaman M, Ali L, Khan AKA, Khan SH. (**2001**) Anti-hyperglycemic effect of *Pterospermum acerifolium* Wild. and *Pterospermum semisagittatum* Ham. *Diabetes Research*, ***35***, 163-170.

[149] Misra TN, Singh RS, Pandey HS, Singh BK. (**1997**) Two new aliphatic compounds *Ruellia tuberosa* Linn. *Indian Journal of Chemistry Section B*, ***36***, 1194-1197.

[150] Lin CF, Huang YL, Cheng LY, Sheu SJ, Chen CC. (**2006**) Bioactive flavonoids from *Ruellia tuberosa*. *Journal of Chinese Medicine*, ***17***, 103-109.

[151] Nair AGR, Subramanian SS. (**1974**) Apigenin glycosides from *Thunbergia fragrans* and *Ruellia tuberosa*. *Current Science*, ***43***. 480.

[152] Samy MN, Khalil HE, Wanas AS, Kamel MS, Sugimoto S, Matsunami K, Otsuka H. (**2013**) Chemical constituents from the leaves of *Ruellia tuberosa*. *Chemistry of Natural Compounds*, ***49***, 175–176.

[153] Phakeovilay C, Disadee W, Sahakitpichan P, Sitthimonchai S, Kittakoop P, Ruchirawat S, Kanchanapoom T. (**2003**) Phenylethanoid and flavone glycosides from *Ruellia tuberosa* L. *Journal of Natural Medicine*, ***67***, 228-233.

[154] Singh RS, Pandey HS, Pandey RP, Singh BK (**2002**) A new triterpenoid from *Ruellia tuberosa* Linn. *Indian Journal of Chemistry - Section B Organic and Medicinal Chemistry*, ***41***, 1754-1756.

[155] Andhiwal CK, Chandra Haas Varshney RP. (**1985**) Phytochemical investigation of *Ruellia tuberosa* L. *Indian* Drugs, ***23***, 49.

[156] Moronkola DO, Aboaba SA, Choudhary IM. (**2015**) Composition of volatile oils from leaf, stem, root, fruit, and flowers of *Ruellia tuberosa* L. (Acanthaceae) from Nigeria. *Journal of Medicinal Plants Research*, ***8***, 1031-1037.

[157] Samy MN, Khalil HE, Sugimoto S, Matsunami K, Otsuka H, Kamel MS. (**2015**) Biological studies on chemical constituents of *Ruellia patula* and *Ruellia tuberosa*. *Journal of Pharmacognosy and Phytochemistry*, ***4***, 64-67.

[158] Chothani DL, Mishra SH. (**2012**) *In vitro* anti-oxidant activity of *Ruellia tuberosa* root extracts. *Free Radicals and Antioxidants*, ***2***, 38-44.

[159] Chen FA, Wu AB, Shieh P, Kuo DH, Hsieh CY. (**2006**) Evaluation of the antioxidant activity of *Ruellia tuberosa*. *Food Chemistry*, ***94***, 14-18.

[160] Rajendrakumar N, Vasantha K, Murugan M, Mohan VR. (**2014**) Antioxidant activity of tuber of *Ruellia tuberosa* L. (Acanthaceae). *International Journal of Pharmacognosy and Phytochemical Research*, ***6***, 97-103.

[161] Khachitpongpanit S, Singhatong S, Sastraruji T, Jaikang C. (**2016**) Phytochemical study of *Ruellia tuberosa* chloroform extract: antioxidant and anticholinesterase activities. *Der Pharmacia Lettre*, ***8***, 238-244.

[162] Arirudran B, Saraswathy A, Krishnamurthy V. (**2011**) Antimicrobial activity of *Ruellia tuberosa* L. (whole plant). *Pharmacognosy Journal*, ***3***, 91-95.

[163] Ullah R, Ibrar M, Hameed I, Hussain F. (**2016**) Pharmacognostic and pharmacological evaluation of *Ruellia tuberosa* L. *Pakistan Journal of Pharmaceutical Sciences*, ***29***, 2099-2102.
[164] Kader MA, Parvin S, Chowduri MAU, Haque ME. (**2012**) Antibacterial, antifungal and insecticidal activities of *Ruellia tuberosa* (L.) root extract. *Journal of Bio-Science*, ***20***, 91-97.
[165] Pardeshi MH, Deshmukh AA, Gajare KA. (**2017**) *Ruellia tuberosa* Linn. acts as anti-fertility agent that reduces sperm count, motility and viability in male Swiss albino mice (*Mus-musculus*). *International Journal of Current Pharmaceutical Research*, ***9***, 105-109.
[166] Pueblos KRS, Lagare JPB, Tapales RVPP, Quimque MTJ. (**2015**) *In vitro* anthelmintic activity evaluation of the aerial part of *Ruellia tuberosa* Linn. against *Eudrilus eugeniae*. *Procedia Chemistry*, ***16***, 570-577.
[167] Rajan M, Kumar VK, Kumar PS, Swathi KR, Haritha S. (**2012**) Antidiabetic, antihyperlipidaemic and hepatoprotective activity of methanolic extract of *Ruellia tuberosa* Linn leaves in normal and alloxan induced diabetic rats. *Journal of Chemical and Pharmaceutical Research*, ***4***, 2860-2868.
[168] Shahwar D, Ullaha S, Ahmad M, Ullah S, Ahmad N, Khan MA. (**2011**) Hypoglycemic activity of *Ruellia tuberosa* Linn (Acanthaceae) in normal and alloxan-induced diabetics rabbits. *Iranian Journal of Pharmaceutical Sciences*, ***7***, 107-115.
[169] Rajesh V, Perumal P. (**2013**) Cytoprotective effect of *Smilax zeylanica* Linn. leaves against Benzo [a] pyrene induced lung cancer with reference to lipid peroxidation and antioxidant system in Swiss albino mice. *Oriental Pharmacy and Experimental Medicine*, ***13***, 267-277.
[170] Thirugnanasampandan R, Mutharaian VN, Bai VN. (**2009**) *In vitro* propagation and free radical studies of *Smilax zeylanica* Vent. *African Journal of Biotechnology*, ***8***, 395-400.
[171] Murali A, Ashok P, Madhavan V. (**2011**) *In vitro* antioxidant activity and HPTLC studies on the roots and rhizomes of *Smilax zeylanica* L. (Smilacacea). *International Journal of Pharmacy and Pharmaceutical Sciences*, ***3***, 192-195.
[172] Rajesh V, Perumal P. (**2014**) Chemopreventive and antioxidant activity by *Smilax zeylanica* leaf extract against N-nitrosodiethylamine induced hepatocarcinogenesis in Wistar albino rats. *Oriental Pharmacy and Experimental Medicine*, ***14***, 111-126.
[173] Rajesh V, Perumal P. (**2014**) *In vivo* assessment of antidiabetic and antioxidant activities of methanol extract of *Smilax zeylanica* leaves in Wistar rats. *Oriental Pharmacy and Experimental Medicine*, ***14***, 127-144.
[174] Jena PK, Dinda SC, Ellaiah P. (**2012**) Antidiabetic activity of various leafy extracts of *Smilax zeylanica* Linn in Streptozotocin induced diabetic rats. *Asian Journal of Chemistry*, ***24***, 4825-4826.
[175] Rajesh V, Perumal P. (2014) In-vitro cytoprotective activity of *Smilax zeylanica* leaves against hydrogen peroxide induced oxidative stress in L-132 and BRL 3A cells. *Oriental Pharmacy and Experimental Medicine*, ***14***, 255-268.
[176] Murali A, Ashok P, Madhavan V. (**2012**) Screening of methanol extract of roots and rhizomes of *Smilax zeylanica* L for hepatoprotective effect against carbontetrachloride induced hepatic damage. *Journal of Experimental and Integrative Medicine*, ***2***, 237-244.
[177] Jena PK, Nayak BS, Dinda SC, Ellaiah P. (**2011**) Investigation on phytochemicals, anthelmintic and analgesic activities of *Smilax zeylanica* Linn. leafy extracts. *Asian Journal of Chemistry*, ***23***, 4307-4310.
[178] Jena PK, Dinda SC, Ellaiah P. (**2012**) Phytochemical investigation and simultaneous study on antipyretic, anticonvulsant activity of different leafy extracts of *Smilax zeylanica* Linn. *Oriental Pharmacy and Experimental Medicine*, ***12***, 123-127.
[179] Bari MA, Islam W, Khan AR. (**2010**) Pesticidal acitivity of *Smilax zeylanica* L. extracts on *Cryptolestes pusillus* (Schon.) (Coleoptera: cucujidae). *Journal of Bangladesh Academy of Sciences*, ***34***, 205-208.
[180] Mungkornasawakul P, Pyne SG, Jatisatienr A, Lie W, Ung AT, Issakul K, Sawatwanich A, Supyen D, Jatisatienr C. (**2004**) Phytochemical studies on *Stemona burkillii* Prain: two new dihydrostemofoline alkaloids. *Journal of Natural Products*, ***67***, 1740-1743.
[181] Sastraruji K, Pyne SG, Ung AT, Mungkornasawakul P, Lie W, Jatisatienr A. (**2009**) Structural revision of stemoburkilline from an E-alkene to a Z-alkene. *Journal of Natural Products*, ***72***, 316-318.
[182] Chanmahasathien W, Ampasavate C, Greger H, Limtrakul P. (**2011**) Stemona alkaloids, from traditional Thai medicine, increase chemosensitivity via P-glycoprotein-mediated multidrug resistance. *Phytomedicine*, ***18***, 199-204.
[183] Xiang W, Li RT, Mao YL, Zhang HJ, Li SH, Song QS, Sun HD. (**2005**) Four new prenylated isoflavonoids in *Tadehagi triquetrum*. *Journal of Agricultural and Food Chemistry*, ***53***, 267-271.
[184] Zhang RT, Cheng GG, Feng T, Cai XH, Luo XD. (2011) Four new isoflavanones from *Tadehagi triquetrum*. *Natural Products and Bioprospecting*, ***1***, 121-123.
[185] Wu J, Zhang CY, Zhang T, Zhao D, An N, Li Y, Zhu N, Wang S, Chen F, Zhang X. (**2015**) A new lignan with hypoglycemic activity from *Tadehagi triquetrum*. *Natural Product Research*, ***29***, 1723-1727.
[186] Zhang X, Chen C, Li Y, Chen D, Dong L, Na W, Wu C, Zhang J, Li Y. (**2016**) Tadehaginosides A-J, phenylpropanoid glucosides from *Tadehagi triquetrum*, enhance glucose uptake via the upregulation of PPARγ and GLUT-4 in C2C12 myotubes. *Journal of Natural Products*, ***79***, 1249-1258.
[187] Zhang X, Wang S, Li Y, Zhao D, An N, Wu J, Zhang T, Wu C, Li Y. (**2015**) Tadehaginoside modulates lipogenesis and glucose consumption in HepG2 cells. *Natural Product Research*, ***29***, 2287-2290.