Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2015; 3(6): 202-216
Received: 07-01-2015
Accepted: 30-01-2015

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A comprehensive review on region based traditional Ayurvedic practitioner's plants secondary metabolites and their phytochemical activities in Bangladesh

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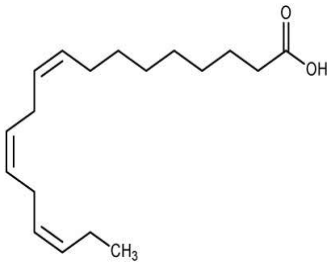
Abstract
Alkaloids are known as low molecular weight heterocyclic nitrogenous compounds naturally derived from amino acid metabolism. Most familiar alkaloids are morphine, strychnine, quinine, ephedrine, nicotine, have a wide distribution in higher plants belonging to Ranunculaceae, Leguminosae, Papaveraceae, Menispermaceae and Loganiaceae families, involved in plant defense against herbivores and pathogens and pronounced bioactivities through the interaction of plants with their environments. At present, medicinal plants and remedies are widely used for various ailments. Many of these plants contain different types of alkaloids are always neurotoxic, pneumotoxic, genotoxic, hepatotoxic and cytotoxic. Alkaloids also have remarkable physiological effects on humans and used to treat Human Immunodeficiency Virus (HIV). Bangladesh is endowed with a very rich flora, and the ancient Bangladesh system of medicine is largely based on plant remedies. For dug designing alkaloids act as a rich reservoir, anti-proliferation, anti-cancer and anti-metastasis both *in vivo* and *in vitro* condition. Principal approach with this comprehensive review is to find out various kinds of alkaloids are extracted from plant species and their metabolic activities.

Keywords: Alkaloids, Microbicidal, Neurotoxic, Cytotoxic, Anti-proliferation, Nicotine and Anti-cancer.

1. Introduction
From the sunrise of civilization medicinal plants are part and parcel of human society to fight diseases commonly used in treating and preventing particular diseases. Medicinal plants are always playing a beneficial function in health care. In a strategy, it is estimated that worldwide 70-80% of people meet their primary healthcare needs mostly by using herbal medicine [23]. In Ayurvedic, Unani and Homeopathic drugs fields are primarily covered by medicinal plants in Indian sub-continent. Approximately, 80% of the remote areas population in Bangladesh greatly depends on traditional remedies for ailments such as cold, fever, headache, cough, and dysentery from around 500 plants. More or less 125 types of medicinal plants are being used in allopathic medicines so medicinal plants are not only appropriate for the preparation of Ayurvedic and Unani medicines but also in allopathic medicines [24]. From the ancient time researchers are working heart and soul with medicinal herbs and from them they found to have definite action on the nervous, circulatory, respiratory, digestive and urinary systems; as well as the sexual organs, the skin, vision, hearing and taste [25, 2]. Alkaloids are important phytochemicals of medicinal plants that can be used as vaccine candidates for viruses. Alkaloids have been isolated for their medicinal value from many Bangladeshi plants.

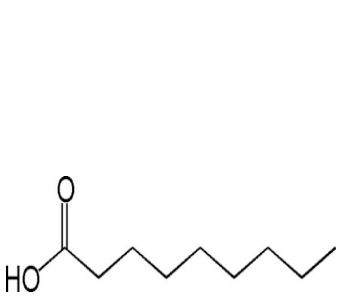
2. Plant based alkaloid and their Activities:
2.1 *Glycine max* (Fabaceae)
Local name: Soya beans.
Local region: Faridpur, rangpur in Bangladesh.
Alkaloids and their activities:
It is generally known as Soya beans. People generally used its seeds. It contains 3-O-methyl-D-chiro-inositol active chemical constituents. [1, 2, 8] There are some ingredients of soya beans such as: α-linolenic acid act as essential fatty acid, hypocholesterolemic, hypotriglyceridemic, improves heart health. Isoflavones act as estrogenic, improves the function of digestive tract, prevent prostate and colon cancer. Lecithins improve the metabolism of lipid; the abilities of

learning also act as anti-carcinogenic, immunostimulator. Peptides play a good role in reducing body fat. Phytosterols act as hypocholesterolemic. Protein act as hypocholesterolemic, antiatherogenic, body fat reduce [86].

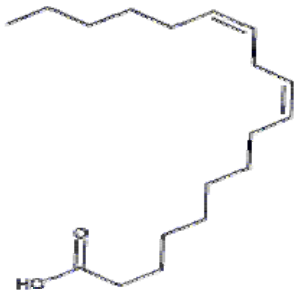


α-Linolenic acid [86]

2.2 *Tamarindus indica* (Fabaceae)
Local name: Tatul tree
Local region: Planted throughout Bangladesh.
Alkaloids and their activities:
Commonly known as Tatul tree, seeds and fruits are its usable portion. It has some active chemical constituents such as flavonoid, polysacc-haride. [2, 3, 8] *Tamarindus indica* contain some fatty acids studied as methyl ester such as: methyl-n-heptanoa, 1-Octanoate, n-Nonanoate, nonanoic acid, n-Tridecanoic, n-Tetradecanoate, methyl-pentadecanoic, n-Hexadecanoate, n-Heptadecanoate, n-Octadecanoic, n-Nonadecanoate, n-Eicosenoate, n-Docosanoate, methyl-n-tricosanoate, n-Tetracosane, methyl-n-Pentadecanoic, n-Hxocosanoate, n-Heptacosanoate, nonacosatrienoic acid, n-Nnacosanate, detricasonic, 9-Decenoate, pentadecatrienoate, heptadacanoate, heptadecadienoat, 10-Octadecenoicacid oleate, nenodecenoic acid, tetracosadienoate, n-Pentacosenoic acid n-Hexacoseoic acid, 24R-Ethyl cholest-5-en, 3β-ol, 9ß, 19-Cyclo-4 ß4, 4, 14, x-trimethyl-5ά-cholestan-3ß-ol [87].

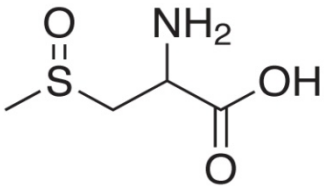


Nonanoic acid [87]



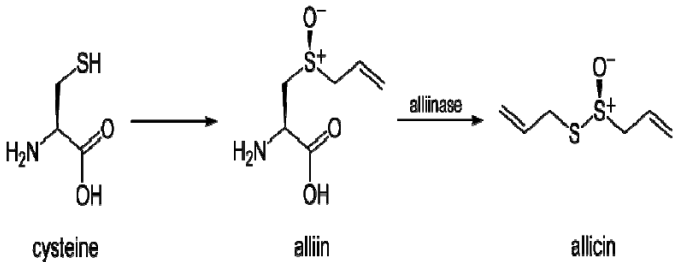
N-Octadecanoic acid [87]

2.3. *Allium cepa* (Alliaceae)
Local name: Piyaj (Bengali)
Local region: Cultivated in most of the districts of Bangladesh.
Alkaloids and their activities:
Allium cepa is usually called onion plant; people generally used its bulb. Onion acts through its active chemical constituents these are S- methyl cysteine sulphoxide and allyl propyl disulphide. [2,4] Research on animal and clinical trials support the use of *Allium cepa* as anti asthmatic [88, 89], anti diabetic [90, 91, 92], anti viral [93, 94] anti thrombotic [95], hypo cholestremic [96], anti inflammatory, anti oxidant, aphrodisiacs, cardiotonic, diueretic [97], expectorant [97], stimulant [97], anti cancer [94], platelet aggregation inhibitor, insecticidal properties, and in osteoporosis treatment [94].

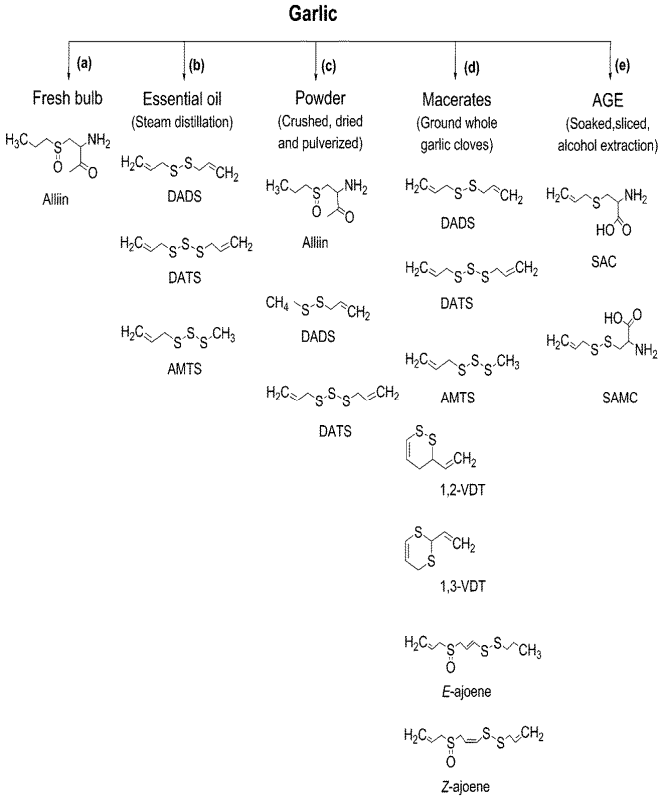


S-Methyl-L-cysteine-S-oxide [2]

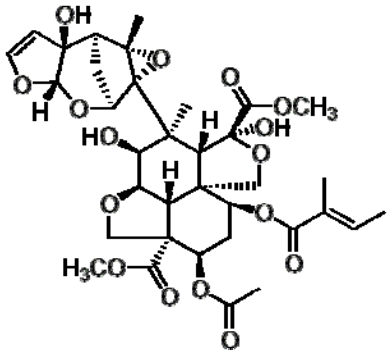
2.4. *Allium sativum* (Alliaceae)
Local name: Rasun (Bangla)
Local region: Cultivated in most of the districts of Bangladesh.
Alkaloids and their activities:
Garlic is a long-familiar medicinal plant in Bangladesh; functional part is root. Ethanolic extract of garlic acts some special thing by holding chemical compounds are ajoene, s-allyl cysteine, allyl propyl disulfide, cysteinediallyl-di-sulphide oxide. [2, 4, 5, 8] The amount of dry weight is 1-5% in *Allium sativum* of cysteine derivatives where the proton at sulfur. Isoalliin, methiin and alliin are found in garlic [98].



The precursor of thiopropanal S-oxide is isoalliin. Most common chemical components are: 2,4,5,7-tetrathiaoctane-2,2-dioxide and 2,4,5,7-tetrathiaoctane from leaves [99], 2,4,5,7-tetrathiaoctane-4-oxide [100], S- methyl-L-cysteine sulfoxide, S-propyl cysteine sulfoxide, S-allyl-L-cysteine sulfoxide [101].

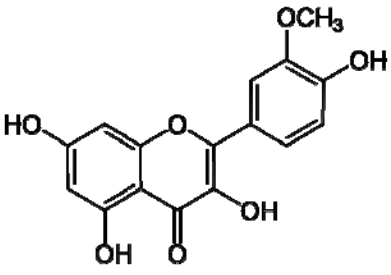


2.5. *Azadirachta indica* (Meliaceae)
Local name: Neem
Local region: Planted all over Bangladesh.
Alkaloids and their activities:
Another important medicinal plant in Bangladesh is *Azadirachta indica* called neem. Plant's leaf and seed are used as many medicinal purpose. Nimbidin is its active chemical compound. [2, 6, 8] Azadirachtin, meliacin, gedunin, nimbidin, nimbolides, salanin, nimbin, and valassin are biologically active phytochemiclas [172], the four best limnoids compounds are: azadirachtin, salannin, meliantriol, and nimbin having insecticidal and pesticidal activity [173]. Pharmacological actions of this plant are includes antinematodal, antipyretic, antispasmodic, insecticidal, antispermatogenic, antitumor, hypercholesteremic, hypoglycaemic, immunomodulator, abortifacient, analgesic, antihelminthic, antibacterial, antiyeast, antiulcer, antifertility, antifilarial, antifungal, antihyperglycemic, anti-inflammatory, antiviral, antimalarial and diuretic activity [174, 175].



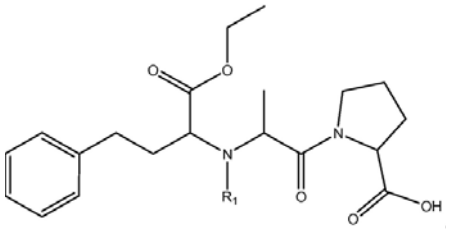
Azadirachtin [172]

2.6. *Brassica juncea* (Brassicaceae)
Local name: Mustard
Local region: Cultivated in different districts.
Alkaloids and their activities:
Brassica juncea is locally known as mustard. Seed and leaf are most usable parts. It has isorhamnetindi glucoside as active chemical compound. [2, 8] Phenolic compounds, carotenoids, glucosinolates are so much rich in this plant which show greater performance of anti-oxidant, hepatoprotective activity, lowering of cardiovascular disease risk and inflammations is performed by linoleic acid and also act as reducing the risk of colon and breast cancer. [156, 157, 158-160] Active antioxidants such as β-carotene, α- tocopherol, indoles and isothiocyanate are also present [161]. Vegetable of *Brassica juncea* contain glucosinolates, flavonoids, vitamins and mineral nutrients [162].



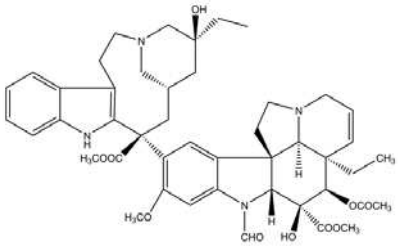
Isorhamnetin [161]

2.7. *Raphanus sativus* (Brassicaceae)
Local name: Mula
Local region: Cultivated widely throughout the country.
Alkaloids and their activities:
Raphanus sativus, whole plant is used as medicinal purpose. [2, 7, 8] Active constituents include pyrrolidine, phenethylamine, nmethylphenethylamine, 1,2′-pyrrolidin-tion-3-il-3-acid-carboxilic-1,2,3,4-tetrahydro-β-carboline, and sinapine [144, 145, 146], α-L-fucopyranosyl-(1-2)-α-L-arabinofuranosyl [147], L-arabinose, D-galactose, L-fucose-4-O-methyl-D-glucuronic acid, and D-glucuronic acid residues [148], 5-vinyl-2 oxazolidinethione, 3-butenyl, 4-pentenyl, and phenethyl isothiocyanate [149], pelargonidin 3-O-[2-O-β-glucopyranosidel)-6-O-(*trans*-p-feruloyl)-β-glucopyranoside]-5-O-(β-glucopyranoside), monoacylated anthocyanins pelargonidin 3-O-[2-O-β-glucopyranosyl)-6-O-(*trans*-p-coumaroyl)-β-D-glucopyranoside]-5-O-(βglucopyranoside) [150], kaempferol-7-O-rhamnoside, isorhamnetin-7-O-rhamnoside, quercetin-7-O-rhamnoside, kaempferol-3-glucoside-7 rhamnoside, kaempferol-7-glucoside-3 rhamnoside, quercetin-7-O-arabinoside-3-glucoside, and quercetin-7-glucoside-3 rhamnoside [154]. Biological activities are antimicrobial [151], antioxidative [152], antitumor [153] and antiviral activity [155].



Pyrrolidine [144]

2.8. *Catharanthus roseus* (Apocynaceae)
Local name: Noyontara
Local region: Planted frequently in home garden.
Alkaloids and their activities:
Generally known as red periwinkle which contain vinculin, Alkaloid as active chemical compounds and almost whole plant is used for mankind. [2, 8] Important alkaloids are vinblastine, ajmalicine, vincristine, anhydrovinblastine, monoterpenoid glucosides (loganin, secologanin, sweroside, deoxyloganin, dehydrologanin), steroids (catasteron, brassinolides), phenols, flavonoids and anthocyanins [163, 164. 165, 166, 167], vindesine (systematic name: 3-(aminocarbonyl)-*O*4-deacetyl-3-de(methoxycarbonyl)-vincaleukoblastine, [168] and vinorelbine (systematic name: 3',4'-didehydro-4'-deoxy-C'-norvincaleukoblastine [169]. Clinical studies reported that these alkaloids perform to lower carcinogenic impression, no neurotoxicity create, well-tolerated effects on hemopoietic tissues, except for transient effects on mature cells of the granulocytic series, also function as a reducing the risk of acute leukemia and partial remissions in malignant lymphomas, chronic lymphocytic leukemia, and multiple myeloma [170, 171].



Vinblastine [163]

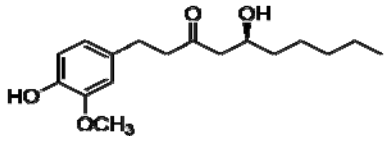
2.9. *Zingiber officinale* (Zingiberaceae)

Local name: Ada.

Local region: Chittagong, Mostly Cultivated all over the country.

Alkaloids and their activities:

Zingiber officinale is a crucial ayurvedic and unani herbal plant known as Ginger. The gingerols is the primary active constituents, 5-hydroxy-1-(4-hydroxy-3-methoxy phenyl) decan-3-one is the most abundant in this constituent. Some other active compounds are mono and sesquiterpenes; camphene, betaphellandrene, curcumene, cineole, geranyl acetate, terphineol, terpenes, borneol, geraniol, limonene, linalool, alpha-zingiberene (30-70%), sesquiphellandrene (15-20%), betabisabolene (10-15%) and alpha-farmesene [137, 138, 139]. Its Bulb is widely used because it contains gingerol, ethanol as active chemical compound [2, 8, 9].



Gingerol [137]

It also contains amadaldehyde, paradols, gingerdiols, gingerdiacetates, gingerdiones, 6-gingersulfonic acid, gingerenones [140]. The primary activities include anti-inflammatory, antioxidant, analgesic effect, anti- proliferative and hepatoprotective activity [141, 142, 143].

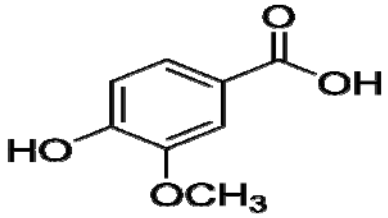
2.10. *Hordeum vulgare* (Poaceae)

Local name: Barley

Local region: Cultivated all over Bangladesh

Alkaloids and their activities**:**

Barley is its local name. [2, 8, 10] Leaf and root are so much biologically beneficial. Possible alkaloids are gramine (*N,N*dimethylindolemethyl-amine) [120, 121, 122, 123], hordenine (N,N-dimethyltriamine) [122, 123], benzoic acid [124], caffeic acid [125], chlorogenic acid [126], coumarin [125], ferulic acid [127], genitisic acid [124], hydroxycinnamic acid [125], P-hydroxybenzoic acid [124], 5-hydroxyferulic acid [128], protocatechuic acid [126], salicylic acid [126], sinapic acid [128], syringic acid [129], vanillic acid [124], flavonoids contains apiginen, lutonarin, saponarin, cyanadin, isovitexin, lutonarin 3'-methyl ether and catechin [184, 185], cyanoglucosides includes heterodendrin, epiheterodendrin, epidermin, sutherlandin, osmaronin, dihydroosmaronin,3-ß-D glucopyranosyloxy-3-methylbutyronitrile, 1-cyano-3-ß-D-glucopyranosyloxy-2-methylpropene,4-D-glucopyranosyloxy-3-hydroxy-3-hydroxymethylbutyronitrile [130, 131, 132], and hydroxamic acid contain 2,4-dihydroxy-1,4-benzoxazin-3-One [133]. *Hordeum vulgare* seed contain beta-glucan which is full of alkaloid properties. Flvonoid act as an inhibition of germination and cell growth, disruption of adenosine triphosphate (ATP) formation, and interference with plant growth regulator (i.e., auxin) function [134].



Vanillic acid [124]

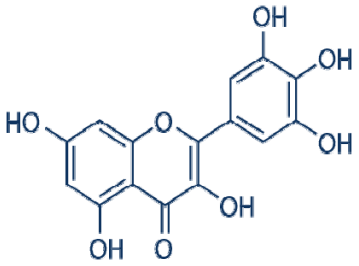
2.11. *Syzygium cumini* (Rutaceae)

Local name: Golapjam.

Local region: Planted all over the country.

Alkaloids and their activities:

The leaves are used as juice with the milk and distributed orally for diabetes treatment [109]. Phytochemical constituents include anthocyanins, ellagic acid, glucoside, isoquercetin, myrecetin, kaemferol, flavonoids and phenolics [110]. Bark contains betulinic acid, β – sitosterol, eugenin, friedelanol, friedelin and epi-friedlanol [111]. There also some others constituents include quercetin, kaempferol, myricetin gallic acid, ellagic acid, flavonoids, tannins, acylated flavanol glycosides, myricetin, myricetin 3-O-4-acetyl-Lrhamnopyranoside, galloyl carboxylase, esterase, acetyl oleanolic acid, eugenol-triterpenoid A and eugenol-triterpenoid B, flavonoid glycosides, isorhamnetin 3-O-rutinoside, raffinose, gallic acid, cyanidingdiglycoside, petunidin, malvidin, delphinidin-3-gentiobioside and malvidin-3-laminaribioside [112-115, 116, 117, 118, 119]. Oral administration of pulp extract of the fruit of *Syzygium cumini* to normoglycemic and STZ induced diabetic rats showed hypoglycemic activity in 30 min possibly mediated by insulin secretion and inhibited insulinase activity. [11, 12]



Myricetin [110]

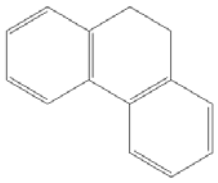
2.12. *Asparagus racemosus* (Liliaceae)

Local name: Shatamuli

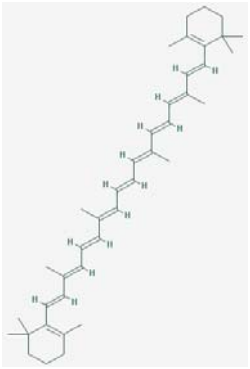
Local region: Cultivated in most of the districts.

Alkaloids and their activities:

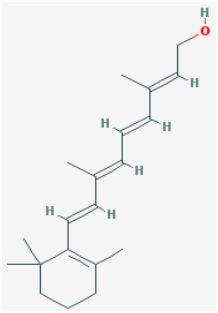
Shatamuli is considered both a general tonic and a female reproductive tonic. Biological significance includes: galactogogue, astringent, antidiarrhoeal, tive, antidysentiric, laxa anticancer, anti-inflammatory, blood purifier, antitubercular, antiepileptic and also in night blindness, antispasmodic, appetizer, and stomach tonic. [81] Active constituents includes: asparinins, asparosides, curillins, curillosides, steroidal saponins, glycoside with 3-glucose, and rhamnose moieties attached to sarsapogenin [82, 83, 84, 85], gamma- linoleinic acids, vitamin A, diosgenin, and quercetin-3-glucourbnides [102, 103], isoflavones - 8-methoxy- 5, 6, 4-trihydroxy, isoflavone-7-0-beta-D-glucopyranoside [104], dihydrophenantherene [105], Root also contain sitosterol, 4,6-dihydryxy-2-O(-2-hydroxy isobutyl) benzaldehyde, undecanyl cetanoate [106], polycyclic alkaloids- aspargamine A, a cage type pyrrolizidine alkaloid [107, 108] Ethanol extract, hexane, chloroform and ethyl acetate fractions of *Asparagus racemosus* root shown to have dose dependent insulin secretion in isolated perfused rat pancreas. These findings reveal that constituents of *asparagus racemosus* root extracts have alkaloid activity [12, 13].



Dihydrophenantherene [105]



Beta carotene [176]



Vitamin A alcohol [177]

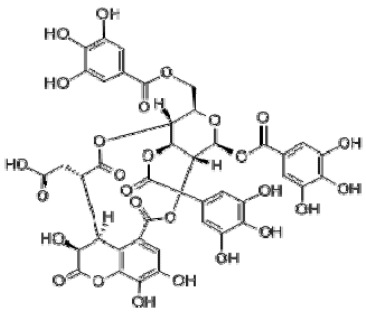
2.13. *Emblica officinalis* (Euphorbiaceae)

Local name: Amla

Local region: Chittagong, Chittagong Hill Tracts, Cox's Bazar, Sylhet, Dhaka-Tangail (Sal forest) and Dinajpur.

Alkaloids and their activities:

Emblica officinalis is lived asamla having tannoid as active chemical compound. [2, 14] Some most important phytochemical constituent includes terpenoids, alkaloids, flavonoids, and tannins [67, 68], linolenic (8.8%), linoleic (44.0%), oleic (28.4%), stearic (2.15%), palmitic (3.0%) and myristic (1.0%) [69], hydrolysable tannins (Emblicanin A, Emblicanin B, punigluconin, pedunculagin) [70], flavonoids (Kaempferol 3 O alpha L (6" methyl) rhamnopyranoside, kaempferol 3 O alpha L (6" ethyl amnopyranoside) [71], phyllantidine and phyllantine [72], gallic acid, ellagic acid, 1-Ogalloyl-beta-D-glucose, 3,6-di-O-galloyl-D-glucose, chebulinic acid, quercetin, chebulagic acid [73], apigenin7-O-(6"-butyryl-beta)-glucopyranoside, along with four known compounds gallic acid, methyl gallate, 1,2,3,4,6-penta-Ogalloylglucose and luteolin-4'Oneohesperiodoside [74], and lupeol [75]. Beneficial use of *Emblica officinalis* includes excellent source of vitamin C [76], Enhance food absorption [77], regulates elimination, nourishes the brain and mental functioning, [78], act as an antioxidant [79], and chelating agent [80].



Chebulinic acid [73]

2.14. *Brassica nigra* (Cruciferae)

Local name: Kalo Sarisha

Local region: Cultivated in different districts.

Alkaloids and their activities:

Externally oil is stimulant, and internally counter irritant. Seeds are emetic; powdered seeds are used as vesicant and rubefacient. Plaster of mustard is medicinally used in gout, sciatica and urticant. Poultices are also useful in febrile and inflammatory symptoms, internal congestions, and spasmodic, neuralgic and rheumatic affections. It is largely used as digestive condiment. Leaves are performed by acting as a stomachic. Constituent of the seeds is composed of glycerides of oleic, stearic and brassic acids. Mostly active ingredients contains proteins, a glycoside, sinigrin and an enzyme, myrosin which, in presence of water, hydrolyses sinigrin to allyl isothiocyanate, potassium hydrogen sulphate and glucose. Other active phytochemical constituents include sinapine sulphocyanate, Goitre prodicing compounds and glucosinols [66]. Oral administration of aqueous of *Brassica nigra* for two months decreased serum glucose level by its alkaloid activity. [12, 15]

Stearic acid [66]

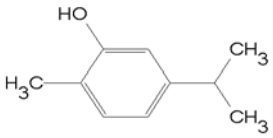
2.15. *Piper betle* (Piperaceae)

Local name: Pan.

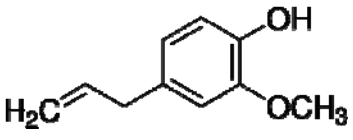
Local region: Sylhet, Kalinjipunji- khasiapunji in Bangladesh

Alkaloids and their activities:

This is well known as Pan, leaf is its usable part which has an alkaloid activity. Primary alkaloid is arakene [48]. Active phytoconstituents include chavibetol, allypyrocatechol, chavibetol acetate, eugenol, piperitol, quercetin, luteolin, beta-sitosterol, hydroxychavicol, alpha-terpineol, allyl catecol, eugenol methyl ether, D-limonene, 2-noanone, 4-allyl phenyl acetate, piperlonguminine, alpha-cadinol, ocimene, N-dacanal, 2-undecanone, myercene, Stearic acid, 2-mono palmitin. allo ocimene, cavacrol, cymene, terpenoline, alpha-myrcene, limonine, vinillin, thymol, cis-piperitol, procatechuic acid, gallic acid, beta- pinene, camphene, linalool, allyl diacetoxy benzene, eucalyptol, sabinene, estragol, anethole, arecoline, benzene acetic acid, iso eugenyl acetate, eugenyl acetate, 4-allyl phenol, caffeic acid, and safrole [49, 50-57]. By its aqueous extract glucose, glycosylated hemoglobin can be diminished. [2, 16, 17] Biological activities include antimicrobial [58], gastroprotective [59], antioxidant [60], antidiabetic [61], platelet inhibition [62], antifertility [63], immunomodulatory [64], and hepato protective activity [65].



Carvacrol [50]



Eugenol [50]

2.16. *Carica papaya* (Caricaceae)

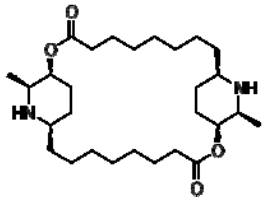
Local name: Pepe

Local region: Widely cultivated throughout Bangladesh.

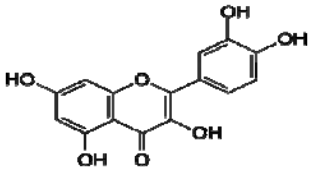
Alkaloids and their activities:

Carica papaya is one of the tasty fruit in Bangladesh that called as Papaya. Active phytochemical constituents includes

alkaloid (Carpaine), flavonoids, tannins, cardiac glycosides, anthraquinone (free), anthraquinone (bound), phlobatinins, and saponins [46, 2, 14]. Its usable portion is mainly fruit. Beneficial effects include cancer cell growth inhibition, antimalarial and antiplasmodial activity [47].



Carpain [46]



Flavonoid [46]

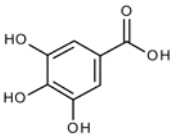
2.17. *Helicteres isora* (Sterculiaceae)

Local name: Atmora.

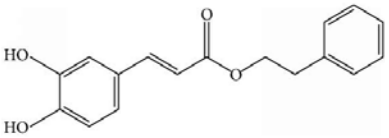
Local region: Sal forests of Dhaka and Tangail in Bangladesh.

Alkaloids and their activities:

This plant is typically known as East Indian screw tree and fruit is used as medicinal purpose. Active phytoconstituents include phenols, flavonoids, alkaloids, glycosides, phytosterols, carotenoids, tannins, gallic acid, caffeic acid, vanillin, p-coumaric acid, isolated rosmarinic acid and their derivatives; isoscutellarein a; D-glucopyranosyl isorinic acid with rosmarinic acid; helisterculins A and B, helisori. By aqueous extract phenolics, steroid, carbohydrate, alkaloid, terpenoid are found. [2, 14]



Gallic acid [40]



Caffeic acid [40]

The most important medicinal use includes antioxidant [42], anticancer [43], anti-diabetic [44, 39, 40, 41] and antimicrobial activity [45]

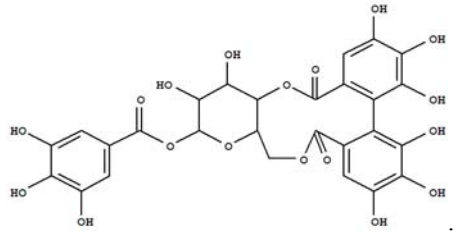
2.18. *Psidium guajava* (Myrtaceae)

Local name: Piyara; Sabri (Mymensingh); Guachi (Chittagong); Gayam (B. Baria).

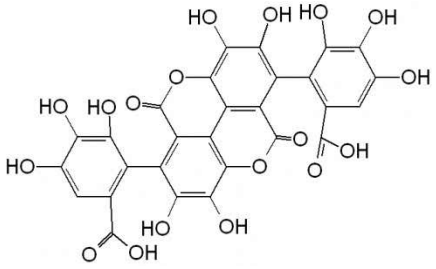
Local region: Planted throug

Alkaloids and their activity:

Guava is very famous as fruit throughout Bangladesh but it has medicinal value as well. The main active constituent of the *Psidium guajava* includes quercetin [37]. *Psidium guajava* also contains glycosides, polyphenols, reducing compounds saponins, tannins etc. With the Aqueous and methanolic extract of leaf some chemical compound as flavonoid, pedunculagin, strictinin, polysaccharide, iso strictinin, terpen can be found, [2, 14, 18] leaves parts are used as an analgesic, antispasmodic, digestive antiseptic, astringent, emollient and healing agent for hemorrhoid treatment [38].



Strictinin [14]



Tannins [18]

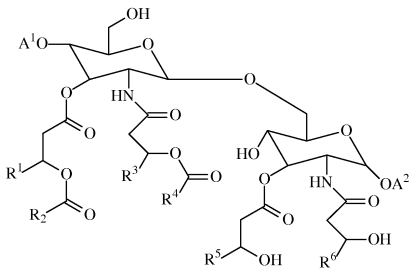
2.19. *Aegle marmelos* (Rutaceae)

Local name: Bel, Shephalbupaong (Tipra); War-e-si Apang (Marma).

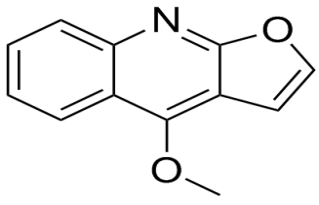
Local region: Cultivated all over Bangladesh.

Alkaloids and their activity:

Aegle marmelos plant is locally called as Golden apple. Leaf, seed and fruit are its used part. Possible alkaloids found from *Aegle marmelos*: aeglin, aegelenine, dictamine, fragrine ($C_{13}H_{11}O_3N$), O-methylhalfordinine, isopentenylhalfordinol, N-2-[4-(3', 3'-dimethylallyloxy) phenyl] ethyl cinnamide, N-2-hydroxy-2-[4-(3', 3'-dimethylallyloxy) phenyl] ethyl cinnamide, N-2-hydroxy-(4-hydroxyphenyl) ethyl cinnamide, O-(3, 3- dimethylallyl) halofordinol, N-2-ethoxy-2-(4-methoxyphenyl) ethyl cinnamide, N-2-methoxy-2-[4-(3', 3'-dimethylallyloxy) phenyl] ethylcinnamide and N-2-methoxy-2-(4-methoxyphenyl)-ethylcinnamide [36]. This can easily increase glycogen, C peptide and glucose tolerance. [2, 19, 20, 21]



Methyl Halfordinine [20]



Dictamine [20]

2.20. *Murraya koenigii* (Rutaceae)

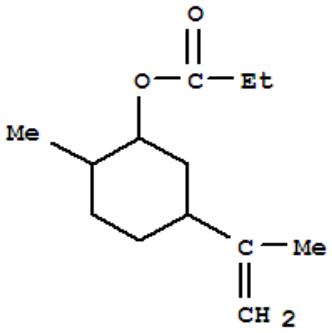
Local name: Chhotokamini, Girinim, Gandhal, Barasunga, Babsanga, Kariaphuli, Pahari Nim, Bhatraj

Local region: Forests of Chittagong, Chittagong Hill Tracts and Sal forests

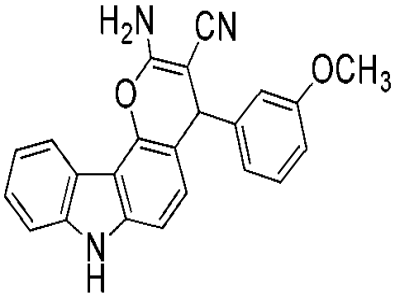
Alkaloids and their activities:

Curry-leaf tree is the common name of *Murrayakoenigii.* The bark of curry-leaf contains carbazole, alkaloids like murrayacine, murrayazolidine, murrayazoline, mahanimbine, girinimbine, murrayastine, murrayaline, pyrayafoline and xynthyletin. It also contains ctystalline glycosides, koenigin, girinimbin, koenine, koenidine and koenimbine in the leaves [26]. The possible triterpenoid alkaloids including cyclomahanimbine, tetrahydromahanimbine its leaf and fruit are mostly used as medicine [2, 22]. Pharmacological properties

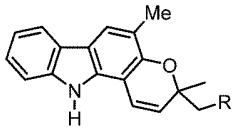
of curry-leaf contains antioxidant [27], anti-nociceptive [28], lipid-lowering [29], anti diabetic [30], immunomodulatory [31], nephroprotective [32], neuroprotective [33], mostly anti-cancer [34] and antibacterial effect [35].



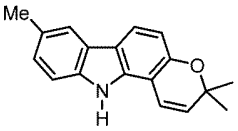
Murrayazolidine [26]



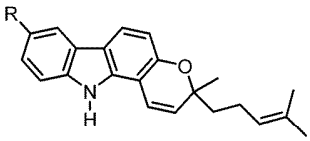
Girinimbine [26]



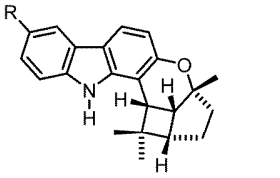
1 Girinimbine R = H
2 Mahanimbine R = prenyl



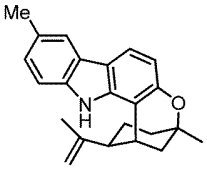
3 Isogirinimbine



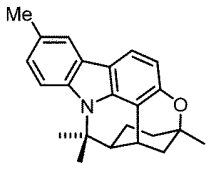
(+)-**4** Mahanimbicine R = Me
(–)-**4** Isomahanimbine R = Me
5 Murrayamine-J R = CHO



6 Bicyclomahanimbicine R = Me
7 Murrayamine-M R = CHO



8 Murrayamine-G



9 Isomurrayazoline

Cyclomahanimbine [2], [22]

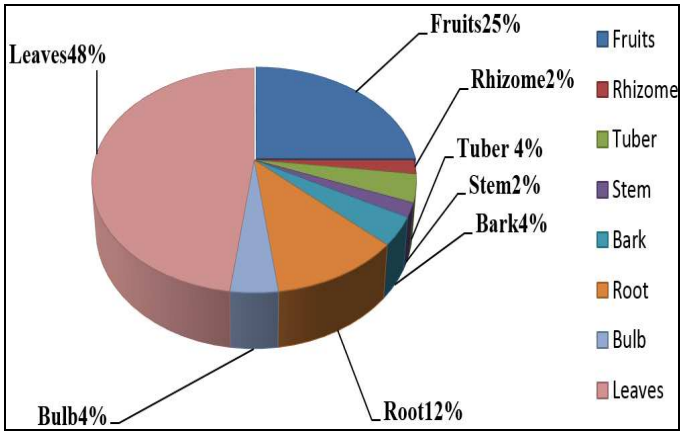


Fig 1: Alkaloid percentage occurrence of plants parts used for medicinal treatment

Table 1: List of plants Alkaloids and their biological activities.

Serial	Name of the plant	Used parts	Active constituents	Biological activities	Reference
01	*Glycine max*	Seeds	3-o-methyl-d-chiro-inositol α-linolenic acid hypotriglyceridemic isoflavones lecithins	improves heart health, function of digestive tract, metabolism of lipid	[1], [2],[86]
02	*Tamarindus indica*	Seeds, Fruits	flavonoid polysacc-haride methyl-n-heptanoa 1-octanoate n-tridecanoic n-tetradecanoate 10-octadecenoic acid n-nnacosanate n-nnacosanate	cleansing blood, mitigate the bad effect of ldl	[3], [8]

Serial	Name of the plant	Used parts	Active constituents	Biological activities	Reference
03	Allium cepa	Bulb	s- methyl cysteine sulphoxide	anti thrombotic, hypo cholestremic, anti inflammatory, anti oxidant, aphrodisiacs, cardiotonic, diueretic, anti diabetic, stimulant	[2], [4],[95], [96], [91], [97]
			allyl propyl disulphide		
04	Allium Sativum	Roots, Bulb	2,4,5,7-tetrathiaoctane-2,2-dioxide	antidiabetic, control the level of cholesterol	[4],[5],[8],[99],[101]
			2,4,5,7-tetrathiaoctane		
			2,4,5,7-tetrathiaoctane-4-oxide		
			s-allyl-l-cysteine sulfoxide		
05	Azadirachta indica	Leaves, Bark.	nimbidin	antipyretic, antispasmodic, insecticidal, antispermatogenic, antitumor, hypercholesteremic, antifungal	[2],[6],[172], [174],[175]
			azadirachtin,		
			meliacin		
			gedunin,		
			nimbolides,		
			salanin,		
			nimbin,		
			valassin		
06	*Brassica juncea*	Seed, Leaves Used parts Seeds	isorhamnetindiglucoside	hepatoprotective, anti-oxidant, lowers cardiovascular disease risk, lowers inflammations	[2],[8],[156],[157],[158],[159]
			phenolic compounds		
			carotenoids,		
			glucosinolates,		
			flavonoids		
			glucosinolates		
07	Raphanus sativus	Whole plant	pyrrolidine,	antimicrobial, antioxidative, antitumor, antiviral	[2],[7],[8], [144], [145], [146], [149], [148],[151],[152],[153]
			phenethylamine,		
			nmethylphenethylamine,		
			sinapine,		
			dglucuronic acid		
			5-vinyl-2 oxazolidinethione,		
08	Catharanthus roseus	Whole plant	vinorelbine	reducing the risk of acute leukemia, partial remissions in malignant lymphomas	[2],[8],[170], [171]
			vindesine		
			steroids		
09	Zingiber officinale	Bulb	ethanol	anti- inflammatory, antioxidant, analgesic, anti- proliferative and hepatoprotective	[2],[8],[9],[141],[142],[143]
			amadaldehyde,		
			paradols,		
			gingerdiols,		
			gingerdiacetates,		
			gingerdiones,		
			6-gingerenones		
10	Hordeum vulgare	Roots	hordenine,	inhibition of germination and cell growth, disruption of adenosine triphosphate (atp) formation, and interference with plant growth regulator (i.e., auxin) function	[121],[122],[123],[124],[125],[126],[127]
			caffeic acid,		
			chlorogenic acid,		
			coumarin,		
			ferulic acid,		
			genitisic acid,		
			hydroxycinnamic acid		

Serial	Name of the plant	Used parts	Active constituents	Biological activities	Reference
11	Syzygium cumini	Leaves	betulinic acid	inhibite insulinase hypoglycemic induced diabetic rats kaempferol,	[109]
			β – sitosterol,		
			eugenin,		
			friedelanol,		
			friedelin		
			epi-friedlanol		
			quercetin,		
12	Asparagus racemosus	Leaves, Roots, Flowers.	asparinins,	galactogogue, astringent, antidiarhoeal, antidysentiric, laxative, anticancer, anti-inflammatory, blood purifier, antitubercular, antiepileptic.	[12],[13],[81], [82],[83],[84]
			asparosides,		
			curillins,		
			curillosides,		
			steroidal saponins,		
			glycoside with 3-glucose		
			rhamnose moieties		
13	Emblica officinalis	Fruits	terpenoids,	regulates elimination, nourishes the brain, act as an antioxidant, and chelating agent	[2],[14],[67], [68],[69],[78],[79],[80]
			alkaloids,		
			flavonoids,		
			tannins,		
			linolenic,		
			linoleic,		
14	Brassica nigra	Seeds	oleic acid	decreased serum glucose level by its alkaloid activity. useful in febrile and inflammatory symptoms, internal congestions.	[12], [15], [66]
			stearic acid		
			brassic acid		
			sinigrin		
			sinapine sulphocyanate		
			glucosinols		
15	Piper betle	Leaves	chavibetol	gastroprotective activity antioxidant activity, antidiabetic activity, platelet inhibition activity, antifertility activity, immunomodulatory activity, and hepato protective activity.	[48], [49], [50], [51], [52], [53], [54], [55], [56], [57],[58], [59].[60], [61],[62], [63], [64], [65].
			allypyrocatechol		
			chavibetol acetate		
			eugenol		
			piperitol		
			quercetin		
			luteolin		
16	Carica papaya	Fruits	carpaine	beneficial effects includes cancer cell growth inhibition, antimalarial and antiplasmodial activity.	[2], [14], [46],[47].
			flavonoids		
			tannins		
			cardiac glycosides		
			anthraquinone		

Serial	Name of the plant	Used parts	Active constituents	Biological activities	Reference
17	Helicteres isora	Leaves, stem, Bark.	phenols	medicinal used includes antioxidant, anticancer, anti-diabetic, and antimicrobial activity medicinal used	[2], [14], [39],[40], [41], [42], [43],[44], [45].
			flavonoids		
			alkaloids		
			glycosides		
			phytosterols		
			carotenoids		
			tannins		
			gallic acid		
			caffeic acid		
18	Psidium guajava	Leaves, Fruits.	glycosides	used as an analgesic, antispasmodic, digestive anticeptic, astringent, emollient healing agent for hemorrhoid treatment	[2], [14], [18], [38]
			reducing compounds		
			polyphenols,		
			saponins		
			terpen		
19	Aegle marmelos	Seeds, Fresh leaves, Fruits.	tannins	increase glycogen, c-peptide and glucose tolerance	[2], [19], [20],[21], [36]
			aeglin		
			dictamine		
			aegelenine		
			fragrine		
			omethylhalfordinine		
			isopentenylhalfordinol		
20	Murraya koenigii	Bark, leaves	mahanimbine,	antioxidant, anti-nociceptive, lipid-lowering, anti diabetic, immunomodulatory, nafroprotective,	[28],[29],[30], [31]
			girinimbine,		
			koenioline,		
			murrayastine,		
			murrayaline,		
			pyrayafoline		
			xynthyletin		

3. Conclusion

The above collected information regarding the 20 Medicinal local plants alkaloids and their significance is matched with available literature. Recent years, ethno-botanical and traditional uses of natural compounds, especially of plant origin received much attention as they are well tested for their efficacy and generally believed to be safe for human use. Our main approach with this comprehensive review of traditional plants, together their most active constituents including alkaloids, Flavonoids and Secondary metabolites for vaster and wide range of easy way to find any required information with their Phytochemical constituents and their activity from this comprehensive review. Recent research is now open for any kind of pharmacology based alkaloid extraction, that's why this review will play a great deal with ethnobotanical research for ayurvedic use of Medicinal plants worldwide. In **Figure 1** we try to focus the percentage of alkaloid or secondary metabolites extracts from plants different parts including Leaf, stem, bark, fruits, root etc. In **Table no. 1** the whole review was discussed with 20 plants which is includes the plants parts usable for medicinal treatment, bioactive constituents, and their biological significance.

4. Conflict of Interests

The authors have declared that there is no conflict of interests.

5. Acknowledgement

We cordially thankful to all teachers from the Department of Biotechnology and Genetic Engineering (BGE), Faculty of Life Science, Mawlana Bhashani Science and Technology University (MBSTU), Tangail-1902, Bangladesh; For their valuable suggestions and inspiration during our Review article proceedings. We also thankful to all teachers from the Department of Biotechnology and Genetic Engineering, Faculty of Applied Science and Technology, Islamic University, Kushtia-7003, Bangladesh, For their valuable suggestions and inspiration.

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