IOSR Journal Of Pharmacy
(e)-ISSN: 2250-3013, (p)-ISSN: 2319-4219
Volume 11, Issue 2 Series. I (February 2021), PP. 51-67
www.iosrphr.org

Medicinal Plants Alkaloids, As a Promising Therapeutics- A Review (Part 1)

Ali Esmail Al-Snafi
Department of Pharmacology, College of Medicine, Thi qar University, Iraq.
Received 21 February 2021; Accepted 6 March 2021

ABSTRACT:
Natural products have gained popularity worldwide for promoting healthcare, as well as disease prevention. Medical use of alkaloid-containing plants has a long history and many alkaloids are still used in medicine nowaday. Alkaloids possessed wide range of pharmacological and therapeutic effects. The current manuscript discussed the plant contents of alkaloids for medical, pharmaceutical, synthetic, and many other useful properties.
KEYWORDS: Medicinal plants, alkaloid, pharmacology, therapeutic

I. INTRODUCTION:

Alkaloids are a huge group of naturally occurring organic compounds which contain nitrogen atom or atoms (amino or amido in some cases) in their structures. These nitrogen atoms cause alkalinity of these compounds. Alkaloids have a wide range of pharmacological effects included ajmaline (antiarrhythmic), colchicin (antigout), emetine (antiprotozoal agent, emesis), ergot alkaloids (vasoconstriction, hallucinogenic, uterotonic), glaucine (antitussive), morphine (analgesic), codiene (analgesic, antitussive), nicotine (nicotinic acetylcholine receptor agonist), physostigmine (acetylcholinesterase inhibitor), quinidine (antiarrhythmic), quinine (antipyretic, antimalarial), reserpine (antihypertensive), tubocurarin (muscle relaxant), vinblastine, vincristine (antitumor), vincamine (vasodilating, antihypertensive), yohimbine (stimulant, aphrodisiac), and many other therapeutic effects[1-3]. The current review was designed to highlight the plant contents of alkaloids for medical, pharmaceutical, synthetic, and many other useful properties.

Medicinal plants contain alkaloids

Adiantum capillus-veneris

The soxhlet extraction of *Adiantum capillus-veneris* showed that it contained 0.53% alkaloids[4-5].

Ailanthus altissima

Alkaloidal glycosides (canthin-6-one, 1-methoxycanthin-6-one, 5-methoxycanthin-6-one, and canthin-6-one-3-N-oxide), were isolated from the root bark of *Ailanthus altissima* [6-7] while, the leaves contained the alkaloid linuthine [8-11].

Ammi majus

Ammi majus seeds contained 0.73 g ergot alkaloids (expressed as ergonovine) per 100g[12-14].

Anagallis arvensis

The seeds of *Anagallis arvensis* contained 2.21 % alkaloids[15-16].

Anagyris foetida

Anagyris foetida contained many alkaloids, included , anagyrine, baptifoline, isorhamnetin, and syringin 4-O-beta-D-glucopyranoside. The crude alkaloid can be separated into cytisine, and anagyrine, the latter is not obtainable in crystalline form; it forms a brittle, resinous-like mass easily reducible to a yellowish powder, but rapidly absorbs moisture and becomes sticky. It volatilizes at 245° C. (473° F.). It forms, however, a crystalline hydrobromide[17-19].

Anachus strigosa

Highest total concentration of pyrrolizidine alkaloids was detected in the leaves of *Anachus strigosa* (23.63 mg/g of dried part), followed by the flowers (19.77 mg/g), and finally by the roots (1.80 mg/g). These pyrrolizidine alkaloids included 7,7′-bis-(4-hydroxy-3,5-dimethoxyphenyl)-8,8′-dihydroxymethyl tetra hydrofuran 4′-*O*-β-*D*-glucopyranoside, rosmarinic acid, caffeic acid, tormentic acid 28-*O*-β-*D*-glucopyranoside, euscaphic acid 28-*O*-β-*D*-glucopyranoside, euscaphic acid, and allantoin . However Braca et al isolated new six pyrrolizidine alkaloids included a new carboxylic acid, a new phenolic and a new oleanane glycoside[20-22].

Andrachne aspera

The aerial parts of *Andrachne aspera* was shown to contain alkaloids, andrachamine , andrachcine, andrachcinine, andrachcinidine, (+)- allosedridine, (-)-8-epi-8-ethylnorlobelol and (-)-8-epihalosaline[23-24]. The aerial parts of *Andrachne aspera* is also contained many piperidine alkaloids, these included aspertin-A , aspertin-B , aspertin-C and aspertin-D [8]. Terpenes isolated from the aerial parts are lupeol acetate, α-amyrin, β-amyrin, α- taraxerol, stigmasterol, β-stigmasterol, lupeol, oleanolic acid and germanicol[25-27].

Antirrhinum majus

Antirrhinum majus contained four tertiary alkaloids, one of which has been identified as 4-methyl-2,6-naphthyridine. A water-soluble base has been identified as choline[28-29].

Arachis hypogaea

Two indole alkaloids were isolated from water-soluble fraction of peanut (*Arachis hypogaea*) skins. The alkaloids were identified as 2-methoxyl-3-(3-indolyl)-propionic acid and 2-hydroxyl-3-[3-(1-N-methyl)-indolyl]-propionic acid[30-31].

Aristolochia maurorum

Three atypical alkaloids (aristolochic acid I, aristolochic acid II and aristolochic acid IIIa), have been isolated from *Aristolochia maurorum*[32].

Arundo donax

Arundo donax contained alkaloids including tryptamine, bufotenidine, gramine and arundamine[33-35].

Astragalus tribuloides

Indolizidine alkaloids, were isolated from *Astragalus tribuloides*[36-37].

Bacopa monniera

Bacopa monniera contained alkaloid brahmine, nicotinine, and herpestine [38-40].

Caccinia glauca

An alkaloid, a diester of retronecine and benzoic acid was isolated from flowers of *Caccinia glauca* [41].

Capparis spinosa

Stachydrine (a pyridine alkaloid), and cadabicine (a 24-membered polyamine lactam alkaloid) were isolated from *Capparis spinosa*[42-45].

***Capsicum* species**

Alkaloid compounds called capsaicinoids were isolated from the fruits of *Capsicum* species[46-49].

Casuarina equisetifolia

Casuarine- a very highly oxygenated pyrrolizidine alkaloid was extracted from *Casuarina equisetifolia*[50-51].

Centaurea cyanus

Analysis of a methanol extract of the seeds of *Centaurea cyanus* gave four indole alkaloids: moschamine, cis-moschamine, centcyamine and cis-centcyamine [52-53].

Chenopodium album

Analysis of the leaves of four *Chenopodium album* cultivars showed that they contained alkaloids 1-27-1.53 mg/100g. Chenoalbicin, a novel cinnamic acid amide alkaloid was isolated from *Chenopodium album*[54-57].

***Citrus* Species**

Citrus aurantifolia, *Citrus limonum* and *Citrus sinensis* fruits contained: alkaloids: 0.33 ±0.11, 0.54 ±0.20, 0.62 ±0.10 mg/ 100g dry weight respectively[58-60].

***Colchicum* Species**

Nine alkaloids (3-demethylcolchicine, 2-demethylcolchicine, colchifoline, N-deacetyl-N-formylcolchicine, colchicine, cornigerine, 2-demethyldemecolcine, 3-demethyldemecolcine and demecolcine were isolated from seven *Colchicum* species. However, although many alkaloids have been identified in Colchicum. The major alkaloid of Colchicum is colchicine. All parts of Colchicum species have been shown to contain colchicine, but seeds and corms contained more colchicine than other plant parts [61-64].

Conium maculatum

Conium maculatum contained piperidine alkaloids (coniine, N-methyl-coniine, conhydrine, pseudoconhydrine, gamma-coniceine), which were formed by the cyclisation of an eight-carbon chain derived from four acetate units. Gamma-coniceine was the precursor of the other hemlock alkaloids. All vegetative organs, flowers and fruits contained alkaloids. The concentrations (both absolute and relative) of the different alkaloids depend on plant varieties, on ecological conditions and on the age of the plant. Conmaculatin (2-Pentylpiperidine), a novel volatile alkaloid related to coniine was identified from the *Conium maculatum* L. Chemical analysis showed that all tissues of *Conium maculatum* were very rich in alkaloids, fruits being the richest with up to 1% (w/w) alkaloid, but the amount and mutual ratio of the several different alkaloids depends on plant variety, ecological conditions and the stage of phenological development[65-69].

Convolvulus arvensis

Convolvulus arvensis was found to contain the tropane alkaloids, tropine, pseudotropine, tropinone as well as cuscohygrine, meso-cuscohygrine and calystegines[70-73].

Crotalaria juncea

Chodesmine alkaloids, 074% of toxic dehydropyrrolizidine alkaloids (DHPAs) (isohemijunceines 0.05%, trichodesmine 0.016%, and junceine 0.008%) were isolated from *Crotalaria juncea*[74].

Cupressus sempervirens

Cupressus sempervirens contained 0.7% alkaloids[75-76].

Cynodon dactylon

Cynodon dactylon contained alkaloids 0.1%[77-78].

Dactyloctenium aegyptium

Dactyloctenium aegyptium leaf extract contained alkaloids 0.540 ± 0.083 mg/g dry weight[79-80].

***Datura* Species**

Tropane alkaloids are a group of more than 200 compounds best known for their occurrence in the family *Solanaceae* comprising over 100 genera and 3000 plant species. Tropane alkaloids characterized by a two-ringed structure with a pyrrolidine and a piperidine ring sharing a single nitrogen atom and two carbon atoms. The amino group, typical for all alkaloids, is in most cases methylated. The most important natural tropane alkaloids are (-)-hyoscyamine and (-)-scopolamine (also known as hyoscine). High concentrations of these alkaloids have been found particularly in *Datura* species. Hyoscine [(-)-Scopolamine] represented the main tropane alkaloid in *Datura fastuosa* (*Datura metel*). However, the plant contained alkaloids, hyosyamine, hyoscine and atropine. The total alkaloid content of the leaves was 0.426% which were mainly atropine. The seeds contained 0.426% and the flower contained 0.43% hyoscyamine. Scopolamine and atropine contents in the whole plant of the plant increased gradually with the progress of developmental growth, and were most pronounced when the plant was at the end of its reproductive stage. The highest percentage of scopolamine accumulation in the root was after 16 weeks. The root was the organ which often accumulated higher amounts of atropine. The aerial parts, if compared with the root of the plant, usually accumulated relatively higher amounts of scopolamine and relatively lower amounts of atropine[81-84].

Production of tropane alkaloids in *Datura stramonium* plants was found to start from the end of the second week after seed germination. The rates of atropine and scopolamine production were similar (0.05%) at this stage. The quantity of alkaloids reached maximum at the end of the tenth week after seed germination, then gradually decreased as the plants entered the generative phase. Alkaloid content depended on the plant part and the stage of plant growth. Leaves and capsules showed the highest alkaloid content in the vegetative and generative phases, respectively. Generally the younger parts of plants contained more alkaloids than older ones. Alkaloid content decreased rapidly in leaves in the generative phase. Scopolamine was lowest (0.013%) in roots in the vegetative period, and then totally disappeared in the generative period. Atropine occurred in roots in both the vegetative (0.045%) and generative (0.056%) periods. Stems were rich in atropine (0.070%) but poor in scopolamine (0.023%) in both stages[84].

The maximum contents of atropine in different parts of *Datura stramonium* were found in the stems leaves and seeds. The maximum contents of hyoscyamine and scopolamine in different parts of *Datura stramonium* were found in the stems and leaves of young plants, hyoscyamine being always the predominant component. In the Young plants, the maximum atropine level was recorded in the stems and medium leaves 0.915 ± 0.015 and 0.831 ± 0.014 µg/mg respectively, while in adult plant , the maximum level of atropine was recorded in the flowers and small leaves 0.270 ± 0.026 and 0.165 ± 0.006 µg/mg respectively. On the other hand, in the Young plants, the maximum scopolamine level was recorded in the stems and flowers 0.129 ± 0.014 and 0.106 ± 0.031 µg/mg respectively, while in adult plant, the maximum level of scopolamine was recorded in the seeds and flowers 0.089 ± 0.010 and 0.066 ± 0.004 µg/mg respectively[85-86]. However, sixty-four tropane alkaloids have been detected in *Datura stramonium* these included: Hygrine; 3á,6â-Ditigloyloxy-7-hydroxytropane; 6-Hydroxyhyoscyamine; Pseudotropine; 3*á*-Tigloyloxytropane; Hydroxy-6-tigloyloxytropane; Phenyl acetoxytropane; 3-Tigloyloxy-6-(2-methylbutyryloxy) tropane; Hyoscyamine; 3-Tigloyloxy-6-isovaleroyloxy-7- Hydroxytropane; Scopolamine; Tropinone; Scopine; 6-Hydroxyacetoxytropane; 3,6-Diacetoxytropane; 3-Tigloxyloxy-6-acetoxytropane; 3-Tigloyloxy-2-methyl butyryl oxytropane; 3á,6â-Ditiglotoxytropane; 3-Acetoxy-6-isobutyryloxytropan; 3-(2-Phenylpropionyloxy) tropane; Littorine; 6-Hydroxy apoatropine; 3â,6â-Ditigloyloxy-7-hydroxytropane; 3-Tropoyloxy-6-acetoxytropane; 3,6-Dihydroxytropane; 3*â*-Tigloyloxytropane; 3-Tigloyloxy-6-propionyloxy-7-hydroxytropane; 3á-Apotro-poyloxytropane; Aposcopolamine; 3â,6â-Ditigloyloxytropane; 3-(3'-Acetoxytropoyloxy) tropane; 3á-Tigloyloxy-6-hydroxyt ropane; Tropine; 3-Acetoxytropane; 3-Hydroxy-6-acetoxytropane; 3-Hydroxy-6-methylbutyryloxytropane; 3-Tigloloxy-6-isobutyryloxytropane;

Aponorscopolamine; 7-Hydroxyhyoscyamine; Meteloidine; 3â,6â-Ditigloyloxytropane; 3-phenylacetoxy-6, 7-epoxynortropane; 7- hydroxyapoatropine and scopoline[84-84].

Delphinium ajacis

The total alkaloidal content of leaf, stem and root of the plant was 3.2, 1.9 and 4.2% w/w respectively, while seeds contained 1.01–1.06% alkaloids[89-91]. The alkaloids delsoline, acetyl delcosine, delcosine, gigactonine, 14-deacetylajadine, ajacine, ambiguine and ajadinine were isolated from the seeds of *Delphinium ajacis*[92-93]. Norditerpenoid alkaloids, ajadelphine, ajadelphinine, delcosine, delsoline, deltaline, gigactonine, 18-methoxygadesine and delphisine were isolated from the roots of *Delphinium ajacis*[94].

Delphinium brunonianum

Delphinium brunonianum contained norditerpenoid and diterpenoid alkaloid (anthriscifoldine)[95]. The norditerpenoid alkaloids which were divided into two main structural groups; the highly toxic MSAL-type and the less toxic MDL-type. Plants high in the MSAL-type alkaloids are thought to be the most toxic to cattle and the concentrations of these alkaloids have been used as a predictor of the plant toxicity[96-98].

Ephedra species

Ephedra species contain alkaloids ephedrine, pseudoephedrine, norephedrine, norpseudoephedrine, methylephedrine, and methylpseudoephedrine. Beside the E-type alkaloids, ephedroxane, and macrocyclic spermidines called ephedradine A-D, which isolated from some Eurasian Ephedra species. The total amount of alkaloids isolated from *Ephedra alata* aerial parts was 0.2-0.22%[99-101].

Equisetum arvense

Alkaloids such as nicotine, palustrine and palustrinine were isolated from the plant[102-103].

Eryngium creticum

The total alkaloids in the plant reached 0.57 ± 0.0058 wt %[104-105].

Eschscholzia californica

Both aerial parts and roots contained alkaloids, the latter being richer than the former, it contained up to 1.6% alkaloids. The alkaloids most commonly reported in *Eschscholzia californica* included sanguinarine, dihydrosanguinarine chelirubine, macarpine, dihydromacarpine, californidine, chelerythrine, dihydrochelerythrine, chelilutine, dihydrochelilutine, sanguirubine, escholtzine, N-methyllaurotetanine, caryachine, O-methylcaryachine, protopine, allocryptopine, reticuline, methyl laurotetanine, hunnemanine, norsanguinarine, pavine alkaloid (6S,12S-neocaryachine-7-O-methyl ether N-metho salt), 1-(3-hydroxy -4-methoxybenzyl) -2-methyl-6,7- methylenedioxy- 1,2,3,4-tetra hydro-isoquinoline, as well as the dihydro-intermediates. The amounts of alkaloids isolated from the aerial part of *Eschscholzia californica* were: protopine : 0.514 ± 0.038, californidine: 12.5 ± 1.8, allocryptopine: 0.0120 ± 0.0023, eschscholtzine: 8.700 ± 0.51, sanguinarine: 0.0191 ± 0.0050, chelerythrine: 0.068 ± 0.011, reticuline: 1.095 ± 0.16, n-methyllaurotetanine: 5.68 ± 0.72 and caryachine: 0.410 ± 0.065 mg/ kg dry weight[106-114].

Eupatorium cannabinum

Pyrrolizidine alkaloids of the *Eupatorium cannabinum* were included echinatine isomers, lycopsamine and intermedine, and a number of their beta-acetyl, beta-angelyl/tiglyl and beta-(iso)valeryl esters. Pyrrolizidine alkaloids without a substituent at C-7 were tentatively identified as supinine and amabiline. In addition to a number of these alkaloids, some beta-(iso)butyryl, beta-angelyl/tiglyl, and beta-(iso)valeryl esters of supinine or amabiline were detected in subterranean parts of the plant. Pyrrolizidine alkaloids with a saturated necine base trachelanthamine isomers and some beta-anglyl/tiglyl esters which were detected in the root material only. A C-9-viridifloryl/trachelanthyl ester of a saturated amino-alcohol like turneforcidine and one of its beta-angelyl/tiglyl esters have also been found[115-118].

Ficus carica

Ficus carica contained crude alkaloid 9.6% /100g dry weight[119-120].

Ficus semicordata

Alkaloid content of the plant leaves was ranging from 18.91±0.16 to 45.68±0.55 mg/gm. The methanolic extract showed more alkaloid content 45.68±0.55 mg/gm than other extracts[121].

Fritillaria imperialis

The bulb was poisonous raw, it contained low concentrations of a toxic alkaloid(12). As well as imperialine, two other alkaloids of molecular formula $C_{27}H_{41}N0_2$ and $C_{27}H_{45}N0_3$ were obtained from bulbs of *Fritillaria imperialis* var. *rubra maxima* [122]. A new class of *C*-nor-d-homo steroidal alkaloids (impranane), impranine and dihydroimpranine, a new pyridyl-pregnane-type steroidal alkaloid, fetisinine and the base korsevine were isolated from the bulbs of *Fritillaria imperialis*[123].

Ebeinone isolated from the bulbs of *Fritillaria imperialis* exhibited anticholinergic activity and completely blocked the responses to acetylcholine[124]. Ebeinone at concentration of (1µg/ml) exhibited anticholinergic activity as manifested by blocking of acetylcholine response in isolated guinea pig ileum and atria[125].

The steroidal bases (impericine, forticine, delavine, persicanidine A, and imperialine) isolated from the ethanol extract of the air-fried bulbs of *Fritillaria imperialis* possessed inhibitory effect on compounds causing anti-acetylcholinesterase and anti-butyrylcholinesterase activity. In order to check the structure-activity relationship and prepare more potent derivatives of imperialine with anticholinergic activity, imperialinol, 3 beta-acetoxyimperialine, 3 beta-propionoxyimperialine, and 3 beta-butyroxyimperialine were prepared. 3 betapropionoxyimperialine, and 3 beta-butyroxyimperialine displayed better anticholinergic activity against muscarinic receptors of the heart and brain than imperialine. The decrease in activity in imperialinol showed the importance of the 6-keto functionality in imparting the anticholinergic activity[126].

The ability of the alkaloid, ebeinone, isolated from *Fritillaria imperialis*, for binding with muscarinic M2 and M3 acetylcholine receptors was investigated. In functional studies with guinea-pig left atrium, ebeinone was found to be 10-fold more active as an antagonist of responses to carbachol (CCh) than in either guinea-pig ileum or trachea. The estimated dissociation constants (KB values) in the three tissues were 77.3, 931.1 and 547.0 nM, respectively. Inhibition binding studies in rat atria with the non-selective antagonist [3H]N-methylscopolamine ([3H]NMS) showed that ebeinone had a KI value of 80.9 nM. Comparison of ebeinone with pancuronium showed that both compoundsable to retard the dissociation rate of [3H]NMS in atria, indicating an allosteric mode of interaction at the M2 receptor[127-128].

Imperialine (cervane alkaloid), was assessed at M1, M2 and M3 receptors in functional assays and at M1, M2, M3 and putative M4 sites in binding studies. In functional assay, imperialine appeared as a selective surmountable antagonist at M2 receptors in guinea-pig isolated atria and uterus (−log KB = 7.7 and 7.4, respectively), in comparison to M1 receptors in canine isolated saphenous vein (−log KB = 6.9) or M3 receptors in a range of guinea-pig isolated smooth muscles including ileum, trachea, fundus, seminal vesicle or oesophagus (−log KB = 6.6–6.8). In rat aorta, the −log KB value at the M3 receptor (5.9) was slightly, but significantly, lower. In competition radioligand binding studies, imperialine was also selective toward M2 sites in rat myocardium (−log Ki = 7.2) with respect to M1 and M3 sites (rat cerebral cortex, rat submaxillary gland; −log Ki = 6.1 and 5.7, respectively). However, it did not significantly discriminate between rat cardiac M2 sites and putative M4 sites in rabbit lung (−log Ki = 6.9)[129].

Fumaria officinalis

The plant contained alkaloids isoquinoline-type. Protopines including protopine (fumarine) as the major alkaloid and cryptopine, protoberberines including aurotensine, stylopine, sinactine and N-methylsinactine. Two new isoquinoline alkaloids, fumaranine and fumarostrejdine, along with 18 known alkaloids were isolated from aerial parts of *Fumaria officinalis* [130].

Total alkaloids was 540 mg/ 100g dry weight of the aerial parts of plants, alkaloids isolated from *Fumaria officinalis* were included : protopine (protopine: 42 mg/100g dry weight, cryptopine: 11 mg/100g dry weight), tetrahydroprotoberine (sinactine: 6 mg/100g dry weight), (adlumine: 2 mg/100g dry weight) and spirobenzyl isoquinoline (parfumine: 2 mg/100g dry weight, fumariline: 3 mg/100g dry weight, fumarophycine: 3 mg/100g dry weight, fumaritine: < 2 mg/100g dry weight)[131]. However, the weight of protopine alone could be reach 230 mg/ 100 g of *Fumaria officinalis* dry weight[132-133].

Fumaria parviflora

The plant contained wide range of alkaloids, the methanolic extraction of 10.5 kg of the plant yielded 0.39% of total alkaloids, the following alkaloids have been identified parfumine, norjusiphine, Nmethyladlumine, d-fumaricine, adlumiceine, adlumidiceine, (+)- adlumidine, (+)-adlumine, (-)-adlumine, (+)-bicuculline, (±)-bicuculline, bicucullinine (narceimine), (-)-cheilanthifoline, coclaurine, coptisine, (-)-corlumine, cryptopine, dehydrocheilanthifoline, dihy drohmariline, dihydrosanguinarine, fumaramidine, fumaramine, fumaridine, fumariflorine ethyl ester, fumarilicine, (+)-fumariline, fumaritine, (+)-α- hydrastine, (+)-isoboldine, izimirine, lahoramine, lahorine, 8- methoxydihy drosanguinarine, methylhydrastinium, N-methyladlumine, N-methylhydrasteine, N-methylhydrastine, N-methyloxohydrasteine, narlumidine, norjuziphine, noroxy- hydrastinine, 8-oxocoptisine, oxysanguinarine, (+)- pahidine, (+)-parfurnine, (+)-parviflorine, protopine, thequaternarysalt of protopine, sanguinarine, (-)-scoulerine, (-)-stylopine, and (±)-stylopine [134-139].

Phthalide isoquinoline alkaloid [(-)-corlumine] and rhoeadines-like alkaloid [rhoeagenine] were isolated from Fumaria parviflora [138, 140].

The Total alkaloids mg/ 100g dry weight of the aerial parts of plants was 521, the quantities of different alkaloids isolated from *Fumaria parviflora* were: protopine (protopine: 57 mg/100g dry weight, cryptopine: 5 mg/100g dry weight), tetrahydroprotoberine (sinactine: 2 mg/100g dry weight), (adlumine: 3 mg/100g dry weight) spirobenzyl isoquinoline (parfumine: 14 mg/100g dry weight, fumariline: 10 mg/100g dry weight, parfumidine: 7 mg/100g dry weight) and benzophenanthridine (dihyrosanguinarine: 2 mg/100g dry weight) [141-142].

Galium aparine

Galium aparine seeds contained 2.76±0.03% alkaloids[143-144].

Glaucium corniculatum

Many alkaloids were isolated from *Glaucium corniculatum*, the phytochemical analysis revealed that *Glaucium corniculatum* of Czechoslovakian origin contained protopine, allocryptopine, corydine, isocorydine, chelirubine, chelidonine, chelery- thrine, sanguinarine, coptisine, berberine, stylopine methohydroxide and canadine methohydroxide. *Glaucium comiculafum* Rud. subspecies refractum from Iran contained dicentrine (0.20%), glaucine (0.18%), dicentrinone (0.17%), dehydrodicentrine (0.05%), (±)-chelidonine (0.07%), α-allocryptopine (0.02%), protopine (0.02%), and N-methyllaurotetanine (0.01%). However. In Egyptian species, the three major alkaloids were, protopine, corydine and isocorydine. The four minor ones were condine N-oxide, isocorydine N-oxide. N-methylcorydine and dihydroprotopine. Protopine, allocryptopine, corydine, isocorydine, chelidonine, berberine were isolated from *Glaucium corniculatum* of Iraqi origin. *Glaucium corniculatum* of Bulgaria origin contained protopines: (protopine, allocryptopine, cryptopine); aporphines: (corydine, isocorydine, norglaucine, glaucine, N-methyllaurotetanine, isoboldine, corunnine); benzophenantridines: (Chelitrytryne, Sanguinarine, Chelidonine); protoberberines: (canadine, berberine) and spirobenzylisoquinolines: (corydaine). While, *Glaucium corniculatum* of Algerian origin contained protopines: (protopine, allocryptopine); aporphines: (corydine, glaucine);
benzophenantridines: (Chelidonine); protoberberines: (canadine, berberine); benzylisoquinolines: (berbitine) and spirobenzylisoquinolines: (corydaine). Glaucine, chelidonine, protopine, allocryptopine and coptizine alkaloids were isolated from *Glaucium corniculatum* from Iasi[145-150].

Glossostemon bruguieri

Glossostemon bruguieri root contained alkaloids (5.8 ± 0.43% of dry raw weight)[151-153].

Gossypium hirsutum

Gossypium hirsutum contained alkaloids 12.20± 0.28%[154-155].

***Haplophyllum* Species**

Haplophyllum buxbaumii contained pyranoquinoline type alkaloid[156]. Alkaloid (+)-tuberine, haplotubinone and haplotubine were also isolated from *Haplophyllum tuberculatum* [156-159].
Quinoline alkaloids and lignan lactones, included: quinoldione, 3-(1′,1′- dimethylallyl) -3-(3″,3″-dimethylallyl) -1,2,3,4-tetrahydro-2,4- quinoldione, 4-(3′,3′-dimethylallyloxy) -3-(3″,3″-dimethylallyl)-2(1H)- quinolone, Polygamain, kusunokinin and 1-methyl-2-n-nonyl-4(1H)- quinolone were isolated from *Haplophyllum tuberculatum*. Haplotubinone and haplotubine alkaloids, were also isolated from the aerial parts of *Haplophyllum tuberculatum* [159-161]. The aerial parts of *Haplophyllum tuberculatum* collected in Sudan yielded the furoquinoline alkaloid skimmianine[162]. Chemical analysis of *Haplophyllum tuberculatum* naturally growing in Saudi Arabia revealed the presence of amide alkaloids, tuberine, tubacetine , tubasenicine and 7-Hydroxy-4- Methoxy-8-prenylfuro[2,3- b]quinolone[163-165].

Hedera helix

Alkaloid (emetin) was isolated from *Hedera helix*[166-167].

Helianthus annuus

Quantitative phytochemical analysis of ethanolic leaf extract of *Helianthus annuus* showed that it contained alkaloid 1.23%[168-169].

***Heliotropium* Species**

Four pyrrolizidine alkaloids (heleurine, heliotrine, supinine, and europine) were isolated from *Heliotropium bacciferum*. The pyrrolizidine alkaloids isolated from the aerial plant parts of *Heliotropium europaeum* were included: supinine-type 2.3 ± 0.4 µg/g dry (included: supinine, supinine-N-oxide, heleurine, heleurine-N-oxide); Heliotrine-type 80.0 ± 7.9 µg/g dry weight **(**included: heliotrine, europine, heliotrine-*N*-oxide, europine-*N*-oxide, rinderine, 5'-hydroxyrinderine, 3'-acetylrinderine, rinderine-N-oxide, 5'-hydroxyrinderine-N-oxide**,** 3'-acetylrinderine-N-oxide, 5'-acetyleuropine, 5'-acetyleuropine-*N*-oxide , echinatine-*N*-oxide); and Lasiocarpine-type 28.7 ± 2.2 µg/g dry weight (included: 7-angeloylheliotrine-*N*-oxide, lasiocarpine**,** lasiocarpine-*N*-oxide**,** *iso*-lasiocarpine, *iso*-lasiocarpine-*N*oxide, 5'-acetyllasiocarpine, 5'-acetyllasiocarpine-*N*-oxide, *iso*acetyllasiocarpine, *iso*-acetyllasiocarpine-*N*-oxide, heliosupine, 3'-acetylheliosupine, heliosupine-*N*-oxide and 3'-acetylheliosupine-*N*oxide). The total pyrrolizidine alkaloid and tertiary base content of the seeds of *Heliotropium europaeum* were found to be 0.28 % and 0.02 % respectively. Higher percentage of alkaloids were present as N-oxides (92.86 % of the alkaloids). Alkaloids found in the tertiary base fraction and total alkaloid fraction were identified as europine 14.27%, heliotrine 2.44%, supinine 9.09%, heleurine 2.65%, lasiocarpine 8.69% and 7-angelylheliotrine 2.86%. *Heliotropium europaeum* population Garmsar was shown to contain three major alkaloids: heliotrine N-oxide 0.08%, lasiocarpine 0.09% and lasiocarpine N-oxide 0.05%; and four minor alkaloids: heliotrine 0.02%, europine 0.02%,

acetyllasiocarpine 0.03% and a novel alkaloid acetyllasiocarpine N-oxide 0.05%. Alkaloid, heliotridine esterified on the methylol hydroxyl with lasiocarpic acid (2,3-dihydroxy-4-methoxy-2-methylpentane-3-carboxylic acid), supinine (supinidine esterified with trachelanthic acid), supinidine esterified with heliotric acid (3-hydroxy-4-methoxy-2-
methylpentane-3-carboxylic acid), N-oxides of heliotrine and lasiocarpine were isolated from *Heliotropium europaeum*[170- 176].

Hibiscus rosa-sinensis

The flower extract of *Hibiscus rosa-sinensis* (Red) contained 0.51±0.16 % alkaloids. While , the flower extract of *Hibiscus rosa-sinensis* (White) contained 0.50±0.18 % alkaloids and the flower extract of *Hibiscus rosa-sinensis* (Yellow) contained 0.48±0.16 % alkaloids [177].

Hibiscus sabdariffa

Hibiscus sabdariffa contained alkaloids 2.14%[178-180].

Hyoscyamus species

All Hyoscyamus species are rich sources of tropane alkaloids, mainly hyoscyamine and scopolamine[181]. The total alkaloid content was 1%. Eighteen alkaloidal compounds were detected, in hairy root cultures of *Hyoscyamus albus* obtained by an infection of plants with *Agrobacterium rhizogenes*, six of the compounds were in trace amounts. However, some of these alkaloids were hygrine, tropinone, tropine, pseudotropine, 3aacetoxytropane, 3 ß-acetoxytropane, cuscohygrine, apoatropine, hyoscyamine, littorine, scopolamine and 6 ß-hydroxyhyoscyamine[182-184].

Thirty-four alkaloids were identified in the roots of *Hyoscyamus albus*, 23 in the stems, 24 in the leaves, 24 for the flowers and 21 in the seeds. The identified alkaloids included: hygrine, cyclotropine, tropinone, tropine, pseudotropine, scopoline, scopine, 2,5-(2-oxopropyl)-hygrine (2,5-diacetonyl-*N*-methylpyrrolidine), 3-(hydroxyacetoxy) tropane, *N*methylpyrrolidinyl- hygrine A, *N*-methylpyrrolidinyl-hygrine B, 3*α*- tigloyloxytropane, cuscohygrine, 3*β*-tigloyloxytropane, 6,7-dehydro-3- phenyl acetoxytropane, 3-phenylacetoxy tropane, 3-(2'-phenylpropionyloxy) tropane (dihydroapoatropine), 6,7-dehydro-3-apotropoyloxytropane, apohyoscyamine, phygrine, 3-phenylacetoxy-6,7- epoxytropane, 6,7-dehydrohyoscyamine, 3-(3'-methoxy tropoyloxy) tropane, 3-phenylacetoxy-6-hydroxytropane, aponor scopolamine, aposcopolamine, *N*-methylpyrrolidinyl-cuscohygrine A, *N*-methyl pyrrolidinyl-cuscohygrine B, hyoscyamine (atropine), 6-hydroxyapo hyoscyamine, scopolamine, 4'-hydroxylittorine, 7-hydroxyhyoscyamine and 6-hydroxy hyoscyamine. Hyoscyamine (atropine) was the major

isolated alkaloid, represented 63.8, 77.8, 70.2, 66.3 and 80.4% of the alkaloids isolated from the roots, stems, leaves, flowers and seeds respectively, followed by scopolamine which represented 4.2, 9.1, 16.6, 16.5 and 6.4% of the alkaloids isolated from the same parts respectively[185].

The main tropane alkaloid of the *H. reticulatus* plant was hyoscyamine in the range from 0.033 to 0.056% dry weight, followed by scopolamine from 0.011 to 0.015% dry weight[186]. The quantitative analysis of *Hyoscyamus reticulates* from Iran showed that it contained 0.031% hyoscyamine and 0.025% scopolamine. The total alkaloid content of the leaves of *H. reticulatus* from Turkey was found to be in the range of 0.011-0.027%[184, 187]. The maximum hyoscyamine and scopolamine concentrations were found in the leaf, and minimum concentration in the stem. Total alkaloids in the leaf, stem and capsule were 0.7126 , 0.2099 and 0.3686 mg/g respectively, and the total alkaloids in the leaf and root of cultured plant were 5.0844 and 0.8556 mg/g respectively. In leaf, stem and capsule of collected plants, hyoscyamine concentrations were 0.3515, 0.0788 and 0.3192 mg/g, and scopolamine concentrations were 0.3611, 0.1311 and 0.0494 mg/g respectively. However, in leaf and root of cultured plant, hyoscyamine concentrations were 2.3377 and 0.1683 mg/g, and scopolamine concentrations were 2.7467 and 0.6873 mg/g respectively[188].

From the *in vitro* hairy root cultures of *Hyoscyamus reticulates*, 10 tropane alkaloids were identified (hydrin, tropin, α-acetyltropin, 11- acetyltropin, cuscohygrin, apoatropin, littorin, hyoscyamine, scopolamine, 6-β-hydroxyhyos cyamine), and 4 from normal plant roots (apoatropin, littorin, hyoscyamine, scopolamine). However, the content of hyoscyamine and scopolamine in the leaves and roots of normal plants was maximal in and before flowering stage, and the maximal folar scopolamine content was before flowering. In the roots the changes in hyoscyamine and scopoamine production were not marked as in the leaves. The changes in the content of both main alkaloids in *Hyoscyamus reticulates* were greater in the leaves than in the roots during different growth periods[189].

Lagerstroemia indica

Biphenyl and biphenyl ether quinolizidine N-oxide alkaloids were also isolated from the plant. Decamine, decinine, decodine, dihydroverticillatine, lagerstroemine and lagerine alkaloids were isolated from *Lagerstroemia indica*[190-193].

Lantana camara

Lantana camara leaves contained 9.76±0.02 mg/g alkaloids[194-195].

Lawsonia inermis

Two alkaloids, harmine and harmaline were also isolated from the ethanol extract of *Lawsonia inermis* leaves[196-197].

Leontice leontopetalum

Leontice leontopetalum contained alkaloids 7.4 ±0.32 mg/g to27.12 ±1.18 mg/g dry weight (leontidine, leontine, leontamine, lupanine, 13α-hydroxy lupanine, α- isolupanin, 3α- hydroxylupanin, leontiformidine, d-leontiformine, pachycarpine, oblongine, petaline, (+) O-methyldihydro secoquettamine and (+) dihydrosecoquettamine) and up to 30% starch. The plant also contained flavones and saponins with a hemolytic index of 1:240 in the aboveground portion of the plant[198-201]. The alkaloid pattern of *Leontice leontopetalum* was characterized by quinolizidine alkaloids of the lupanine-type with lupanine as the main compound. In *Leontice leontopetalum* L. subsp. *ewersmannii* 15 quinolizidine alkaloids were detected, in contrast to *Leontice leontopetalum, L. ewersmannii* accumulated quinolizidine alkaloids of the matrine-type and the α-pyridone-type was the major compounds[198-200].

Lippia nodiflora

Lippia nodiflora contained 0.589% alkaloids [201-203].

Lithospermum officinale

Two pyrrolizidine alkaloids, O-7- 3-hydroxy-3-methylbutanoyl-O-9-(-)-hydroxy viridifloryl retronecine and its acetyl derivative were isolated from *Lithospermum officinale*[204-205].

Lolium temulentum

Analysis of the overground part of *Lolium temulentum* led to the isolation of two main alkaloids: loline and perloline. Loline and two minor alkaloids (2-hydroxy -7- methoxy-1-methylamino and the corresponding 1-aminopyrrolizidine) were strictly localized in
the caryopses, whereas perloline was found mainly in the stems[206].

Luffa acutangula

The fruit of *Luffa acutangula* contained 0.19 mg/kg alkaloids[207-208].

Lycium barbarum

Two steroidal alkaloid glycosides were isolated from the seeds of *Lycium barbarum*[209].

Lythrum salicaria

Diffeerent parts of *Lythrum salicaria* contained: alkaloids (piperidine and quinolizidine derivatives: lythranine, lythranidine, lythra mine, lythrancineI–VII, lythrancepineI–III)[210-212].

Mangifera indica

The mango stem bark and leaves contained 9.66 ± 0.20 and 0.84 ± 0.11 mg/ 100g alkaloids[213].

Marrubium vulgare

Alkaloids (emetine and cephaeline) were isolated from *Marrubium vulgare* [214].

Medicago sativa

Medicago sativa contained include alkaloids (stachydrine, homostachydrine)[215].

Mirabilis Jalapa

Mirabilis Jalapa leaves contained 0.034mg/kg alkaloids[216-217].

Oxalis corniculata

Quantitative phytochemical analysis of *Oxalis corniculata* showed that total alkaloids
of the plant was (0.86 mg/kg)[218-219].

Narcissus tazetta

Many alkaloids: pretazettine, tazettine, homolycorine, haemanthamine,ismine, narcisine,narciclasine,lycorine, pseudolycorine, pseudolycorine N-oxide, galanthamine, nor-galanthamine, 11- hydroxygalanthine,buphanisine, haemantamine, 3-epihydroxy
bulbispermine *O*- methylmaritidine, 9-*O*-Demethylhomolycorine, 3-epi hydroxybulbispermine and N-methyl-8,9-methylenedioxyphenantridinium were isolated from *Narcissus tazetta*[220-224].

II. CONCLUSION

Medical use of alkaloid-containing plants has a long history and many alkaloids are still used in medicine nowaday. The current manuscript discussed the plant contents of alkaloids for medical, pharmaceutical, synthetic, and many other useful properties.

REFERENCES:

[1]. Cushnie TP, Cushnie B and Lamb AJ. Alkaloids: An overview of their antibacterial, antibiotic-enhancing and antivirulence activities. Int J Antimicrob Agents 2014; 44 (5): 377–386.

[2]. Qiu S, Sun H, Zhang AH, Xu HY, Yan GL, Han Y and Wang XJ. Natural alkaloids: basic aspects, biological roles, and future perspectives. Chin J Nat Med 2014; 12(6): 401-406.
[3]. Robert A. Meyers Encyclopedia of Physical Science and Technology - Alkaloids, 3rd edition. Academic Press 2001.
[4].Akabori Y and Hasagava M. Flavonoid pattern in the pteridaceae Ⅱ, Flavoniod consistituents in the frounds of *Adiantum Capillus-Veneris* and A. Cuneatum [J]. Shokubutsugaku Zasshi 1969; 82:294-297.
[5]. Al-Snafi AE. The chemical constituents and pharmacological effects of *Adiantum capillus-veneris* - A review. Asian Journal of Pharmaceutical Science and Technology 2015; 5(2): 106-111.
[6]. Zhang LP, Wang JY, Wang W, Cui YX and Cheng DL. Two new alkaloidal glycosides from the root bark of *Ailanthus altissima*. J Asian Nat Prod Res 2007; 9(3-5): 253-259.
[7]. Anderson LA, Harris A and Phillipson JD. Production of cytotoxic canthin-6-one alkaloids by *Ailanthus altissima* plant cell cultures. J Nat Prod 1983;46(3):374-378.
[8]. Duke JA. and Wain KK. Medicinal plants of the world. Computer index with more than 85,000 entries,1981.
[9]. List PH. and Horhammer L. Hager's handbuch der pharmazeutischen praxis. Vols 2–6. Springer-Verlag, Berlin 1969-1979.
[10]. Perry LM. Medicinal plants of east and southeast Asia. MIT Press, Cambridge 1980.
[11]. Al-Snafi AE. The pharmacological importance of *Ailanthus altissima*- A review. International Journal of Pharmacy Review and Research 2015; 5(2):121-129
[12]. Odriozola E. Fotosensibilización y queratoconjuntivitis en rumiantes por consumo de semillas de falsa viznaga (*Ammi majus* L.). Vet Argent 1984; 1: 684-688.
[13]. Shlosberg A, Egyed M and Eilat A. The comparative photosensitizing properties of *Ammi majus* and *Ammi visnaga* in goslings. Avian Dis 1974; 18: 544-550.
[14]. Al-Snafi AE. Chemical constituents and pharmacological activities of *Ammi majus* and *Ammi visnaga*. A review. International Journal of Pharmacy and Industrial Research 2013; 3(3):257-265.
[15]. Abbas MN , Rana SA, Shahid M, Rana N, Mahmood-ul-Hassan M and Hussain M. Chemical evaluation of weed seeds mixed with wheat grains at harvest. The Journal of Animal & Plant Sciences 2012; 22(2): 283-288.
[16]. Al-Snafi AE. The chemical contents and pharmacological effects of *Anagallis arvensis* - A review. International Journal of Pharmacy 2015; 5(1): 37-41.
[17]. Innocenti G, Dall'Acqua S, Viola G, Loi MC. Cytotoxic constituents from *Anagyris foetida* leaves. Fitoterapia 2006 ;77(7-8): 595-597.
[18]. Schmeller T, Sauerwein Sporer F, Wink M, Muller WE. Binding of quinolizidine alkaloids to nicotinic and muscarinic acetylcholine receptors. J Nat Prod 1994; 57: 1316-1319.
[19]. Henry TA. The plant alkaloids IV , Ed. Philadelphia – Toronto. The blakiston Co 1949 P116. Goebmann, G. Ueber die Alkaloide von *Anagyris foetida*. Eingegangen den 1906: 3 ,1.
[20]. Siciliano T, Leo MD, Bader A, Tommasi ND, Vrieling K, Braca A and Morelli I. Pyrrolizidine alkaloids from *Anchusa strigosa* and their antifeedant activity. Phytochemistry 2005; 66(13):1593-1600.
[21]. Braca A, Bader A, Siciliano T, Moreelli I and Tommasi ND. New Pyrrolizidine Alkaloids and Glycosides from *Anchusa strigosa*. Planta Med 2003; 69(9): 835-841.
[22]. Al-Snafi AE. The pharmacology of *Anchusa italica* and *Anchusa strigosa*- A review. International Journal of Pharmacy and Pharmaceutical Sciences 2014; 6(4): 7-10.
[23]. Mill S, and Hootele C. Alkaloids of *Andrachne aspera*. J Nat Prod 2000; 63(6): 762-764.
[24]. Nasir MA. Investigation of chemical constituents of *Andrachne aspera* and Porania pulvillus, Karachi University, Pakistan 1986 .
[25]. Kamal A. Studies in the chemical constituents of *Andrachne aspera* Spreng. (Euphorbiaceae). PhD thesis, University of Karachi, Karachi, Pakistan 2001:175.
[26]. Al-Snafi A. Encyclopedia of chemical constituents and pharmacological effects of Iraqi medicinal plants. Rigi Pubication, 2015.
[27]. Schmelzer, G.H., 2008. *Andrachne aspera* Spreng. Internet Record from PROTA4U. Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://www.prota4u.org/search.asp [15 October 2014].
[28]. Harkiss K J. Studies in the scrophulariaceae – part III investigation of the occurrence of alkaloids in Antirrhinum majus L. Planta med.1964, 12, 460 .
[29]. Al-Snafi AE. The pharmacological importance of *Antirrhinum majus* - A review. Asian J of Pharm Sci & Tech 2015; 5(4): 313-320.
[30]. Lou H, Yuan H, Yamazaki Y, Sasaki T, and Oka S. Alkaloids and flavonoids from peanut skins. Planta Med 2001; 67(4):345-349.

[31]. Al-Snafi AE. Chemical constituents and pharmacological activities of *Arachis hypogaea* - A review. International Journal for Pharmaceutical Research Scholars 2014; 3(1-1): 615-623.
[32]. Alali F Q, Tawaha K, Shehadeh M B, and Telfah S. Phytochemical and biological investigation of *Aristolochia maurorum* L. Z Naturforsch C 2006; 61(9-10): 685-691.
[33]. Shatalov AA, Quilhó T and Pereira H. *Arundo donaxL*. reed: new perspectives for pulping and bleaching1.raw material characterisation. Tappi Journal Review Edpaper 2001; 84 (1):1-12.
[34]. Ghosal S, Chaudhuri RK and Dutta SK. Alkaloids of the flowers of *Arundo donax L*. Phytochemistry 1971; 10:2852-2853.
[35]. Al-Snafi AE. The constituents and biological effects of *Arundo donax* - A review. International Journal of Phytopharmacy Research 2015; 6(1): 34-40.
[36]. Kemper K J, and Small R. Astragalus (*Astragalus membranaceous*) 1999. Longwood Herbal Task Force: http://www.mcp.edu/herbal/default.htm
[37]. Al-Snafi AE. Chemical constituents and pharmacological effects of *Astragalus hamosus* and *Astragalus tribuloides* grown in Iraq. Asian J of Pharm Sci & Tech 2015; 5(4): 321-328.
[38]. Chopra RN, Nayar L and Chopra IC. Glossary of Indian Medicinal Plants, Vol 32, Council of Scientific and Industrial Research, New Delhi 1956.
[39]. Sastri MS, Dhalla NS and Malhotra CL. Chemical investigation of *Herpestis monniera* Linn (Brahmi). Indian J Pharmacol 1959; 21: 303-304.
[40]. Al-Snafi AE. The pharmacology of *Bacopa monniera*. A review. International Journal of Pharma Sciences and Research 2013; 4(12): 154-159.
[41]. Siddiqi M A , Suri K A , Suri O P and Atal C K. A new pyrrolizidine alkaloid from *Caccinia glauca*. Phytochemistry 1978;17(11):2049-2050.
[42]. Sushila R, Permender R, Dharmender R, Deepti R and Vikash K. Phytochemical and pharmacological potential of Kair (Capparis Decidua). Int J Phytomed 2010; 2: 10-17.
[43]. Al-Said MS, Abdelsattar EA, Khalifa SI and El-Feraly FS. Isolation and identification of an anti-inflammatory principle from *Capparis spinosa*. Pharmazie 1988; 43: 640-641.
[44]. Inocencio C, Alcaraz F, Calderón F, Obón C, Rivera D. The use of floral characters in Capparis sect. Capparis' to determine the botanical and geographical origin of capers. European Food Res Technol 2002; 214(4): 335-339.
[45]. Al-Snafi AE. The chemical constituents and pharmacological effects of *Capparis spinosa* - An overview. Indian Journal of Pharmaceutical Science and Research 2015; 5(2): 93-100.
[46]. Richter J and Schellenberg I. Comparison of different extraction methods for the determination of essential oils and related compounds from aromatic plants and optimization of solid-phase microextraction/ gas chromatography. Anal Bioanal Chem 2007; 387: 2207–2217.
[47]. Salveson A and Svendsen AB. Gas liquid chromatographic separation and identification of the constituents of caraway seed oil: I; The monoterpene hydrocarbons. Planta Med 1976; 8: 93–96.
[48]. Sedlakova J, Kocourkova B and Kuban V. Determination of essential oil content and composition in caraway (*Carum carvi L.*). Czech J Food Sci 2001;19: 31-36.
[49]. Al-Snafi AE. The pharmacological importance of Capsicum species (*Capsicum annuum* and *Capsicum frutescens*) grown in Iraq. Journal of Pharmaceutical Biology 2015; 5(3): 124-142.
[50]. Nash R, Thomas P, Waigh R. Casuarine- a very highly oxygenated pyrrolizidine alkaloid. Tet Lett 1994; 35 (42), 7849-7852.
[51]. Al-Snafi AE. The pharmacological importance of *Casuarina equisetifolia* - An overview. International Journal of Pharmacological Screening Methods 2015; 5(1): 4-9.
[52]. Sarker S D, Laird A, Nahar L, Kumarasamy Y and Jaspars M. Indole alkaloids from the seeds of *Centaurea cyanus* (Asteraceae). Phytochemistry 2001;57(8):1273-1276.
[53]. Al-Snafi AE. The pharmacological importance of *Centaurea cyanus*- A review. Int J of Pharm Rev & Res 2015; 5(4): 379-384.
[54]. Adedapo A, Jimoh F and Afolayan A. Comparison of the nutritive value and biological activities of the acetone, methanol and water extracts of the leaves of *Bidens pilosa* and *Chenopodium album*. Acta Pol Pharm 2011; 68(1):83-92.
[55]. Al-Snafi AE. The chemical constituents and pharmacological effects of *Chenopodium album* - An overview. International J of Pharmacological Screening Methods 2015; 5(1): 10-17.
[56]. Sood P, Modgil R, Sood M and Chuhan PK. Anti-nutrient profile of different Chenopodium cultivars leaves. Annals Food Science and Technology 2012; 13(1):68-74.
[57]. Cutillo F, D'Abrosca B, Della Greca M and Zarrelli A. Chenoalbicin, a novel cinnamic acid amide alkaloid from *Chenopodium album*. Chem Biodivers 2004; 1(10): 1579-1583.
[58]. Okwi DE and Emenike IN. Evaluation of the phytonutrients and vitamins contents of citrus fruits. International J Molecular Medicine and Advance Sciences 2006; 2(1):1-6.

[59]. Okwu DE.Citrus fruits: A rich source of phytochemicals and their roles in human health. Int J Chem Sci 2008; 6(2): 451-471.
[60]. Al-Snafi AE. Nutritional value and pharmacological importance of citrus species grown in Iraq. IOSR Journal of Pharmacy 2016; 6(8): 76-108.
[61]. Düen O and Sümbül H. A Morphological investigation of colchicum L. (Liliaceae) species in the mediterranean region in Turkey. Turc J Bot 2007; 31: 373-419.
[62]. Ondra P, Valka I, Vicar J, Sutlupinar N and Simanek V. Chromatographic determination of constituents of the genus Colchicum (Liliaceae). J of Chromatography A 1995; 704(2):351-356.
[63]. Ondra P, Valka I, Vicar J, Sutlupinar N and Simanek V. Chromatographic determination of constituents of the genus Colchicum (Liliaceae). The International Symposium on Chromatographic and Electrophoretic Techniques, Bled, Slovenia, October 10-13, 1994.
[64]. Al-Snafi AE. Medicinal importance of *Colchicum candidum*- A review. The Pharmaceutical and Chemical Journal 2016; 3(2):111-117.
[65]. Vetter J. Review: Poison hemlock (*Conium maculatum* L.). Food and Chemical Toxicology 2004; 42(9): 1373–1382.
[66]. Radulovic N, Dordevic N, Denic M, Pinheiro MMG, Fernandes PD and Boylan F. A novel toxic alkaloid from poison hemlock (*Conium maculatum* L., Apiaceae): Identification, synthesis and antinociceptive activity. Food and Chemical Toxicology 2012;50: 274–279.
[67]. Corsi G and Biasci D. Secretory structures and localization of alkaloids in *Conium maculatum* L. (Apiaceae). Ann Bot 1988; 81: 157–162.
[68]. Lopez TA, Cid MS and Bianchini ML. Biochemistry of hemlock (*Conium maculatum* L.) alkaloids and their acute and chronic toxicity in livestock. A Rev Toxicon 1999; 37: 841–865.
[69]. Al-Snafi AE. Pharmacology and toxicology of *Conium maculatum*- A review. The Pharmaceutical and Chemical Journal 2016; 3(2):136-142.
[70]. Meng XL, Riordan NH, Casciari JJ, Zhu Y, Zhong J and González MJ. Effects of a high molecular mass *Convolvulus arvensis* extract on tumor growth and angiogenesis. P R Health Sci J 2002; 21:323-328.
[71]. Todd FG, Stermitz FR, Schultheis P, Knight AP and Traub-Dargatz J. Tropane alkaloids and toxicity of *Convolvulus arvensis*. Phytochemistry 1995;39(2)301-303.
[72]. Salehi B, Krochmal-Marczak B, Skiba D, Patra JK, Das SK Das G, Popović- Djordjević JB, Kostić AZ, Kumar NV, Tripathi A, Al-Snafi AE, Arserim-Uçar DK, Konovalov DA, Csupor D, Shukla I, Azmi L, Mishra AP, Sharifi-Rad J, Sawicka B, Martins N, Taheri Y, Fokou BVT, Capasso R and Martorell M. *Convolvulus* plant- A comprehensive review from phytochemical composition to pharmacy. Phytotherapy Research 2019;1–14.
[73]. Al-Snafi AE. The chemical constituents and pharmacological effects of *Convolvulus arvensis* and *Convolvulus scammonia*- A review. IOSR Journal of Pharmacy 2016; 6(6): 64-75.
[74]. Al-Snafi AE. The contents and pharmacology of *Crotalaria juncea*- A review. IOSR Journal of Pharmacy 2016; 6(6): 77-86.
[75]. Emami SA, Khayyat MH, Rahimizadeh M, Fazly-Bazzazb S and Assili J. Chemical constituents of *Cupressus sempervirens* L cv. cereiformis Rehd essential oils. Iranian Journal of Pharmaceutical Sciences 2005;1(1): 33-36.
[76]. Al-Snafi AE. Medical importance of *Cupressus sempervirens*- A review. IOSR Journal of Pharmacy 2016; 6(6): 66-76.
[77]. Jolly CI and Narayanan P. Pharmacognosy of aerial parts of *Cynodon dactylon* Pers. (Graminae). Ancient Science of Life 2000; XIX (3&4): 1-6.
[78]. Al-Snafi AE. Chemical constituents and pharmacological effects of *Cynodon dactylon*- A review. IOSR Journal of Pharmacy 2016; 6(7): 17-31.
[79]. Babu R and Savithramma N. Phytochemical screening of underutilized species of Poaceae. JPR: Bio MedRx: An International Journal 2013; 1(10): 947-951.
[80]. Al-Snafi AE. The pharmacological potential of *Dactyloctenium aegyptium*- A review. Indo Am J P Sci 2017; 4(01): 153-159.
[81]. European Food Safety authority. Tropane alkaloids (from *Datura* sp.) as undesirable substances in animal feed. The EFSA Journal 2008; 691: 1-55.
[82]. Afsharypuour S, mostajeran A and Mokhtany R. Variation of scopolamine and atropine in different parts of *D. metel* during development plant. Medicine 1995; 61: 383-384.
[83]. Bauzidi A, Mahdeb N and Kara N. Toxicity studies of alkaloids of seeds of *Datura stramonium* and synthesis alkaloids in male rats. J Med Plants Res 2011; 5 (15): 342-343.
[84]. Al-Snafi AE. Medical importance of *Datura fastuosa* (syn: *Datura metel*) and *Datura stramonium* - A review. IOSR Journal of Pharmacy 2017; 7(2):43-58.

[85]. Devi MR, Bawari M, Paul SB and Sharma GD. Neurotoxic and medicinal properties of *Datura stramonium* L. – Review. Assam University Journal of Science & Technology Biological and Environmental Sciences 2011; 7(I): 139-144.
[86]. Elisabetta M, Alessandra M, Ferri S and Comparini IB. Distribution of hyoscyamine and scopolamine in *Datura stramonium.* Fitoterapia 2001; 72(6) : 644-648.
[87]. Sayyed A and Shah M. Phytochemistry, pharmacological and traditional uses of *Datura stramonium* L. review. Journal of Pharmacognosy and Phytochemistry 2014; 2 (5): 123-125.
[88]. Berkov S, Zayed R and Doncheva T. Alkaloid patterns in some varieties of *Datura stramonium.* Fitoterapia 2006; 77 (3):179-182.
[89]. Lu J, Desai HK, Ross S and Pelletier W. New norditerpenoid alkaloids from the leaves of *Delphinium ajacis*. Journal of Natural Products 1993; 12(56): 2098-2103.
[90]. Liang XH and Ross SA. Norditerpenoid alkaloids from the stems and leaves of *Delphinium ajacis*. Journal of Natural Products 1991; 54(5): 1283-1287.
[91]. Khare CP. Indian medicinal plants, an illustrated dictionary. Springer Science and Business Media, LLC 2007: 206-207.
[92]. Desai HK, Cartwright BT and Pelletier SW. Ajadinine: a new norditerpenoid alkaloid from the seeds of *Delphinium ajacis*. The complete NMR assignments for some lycoctonine-type alkaloids. J Nat Prod 1994; 57(5):677–682.
[93]. Waller GR, Sastry SD and Kinneberg KF. Mass spectra of lycoctonine-type diterpenoid alkaloids from *Delphinium ajacis* and their derivatives. Proc Okia Acad Sci 1973; 53: 92-97.
[94]. Pelletier SW, Bhandaru S, Desai HK, Ross SA and Sayed HM. Two new norditerpenoid alkaloids from the roots of *Delphinium ajacis*. J Nat Prod 1992; 55(6):736–743.
[95]. Deng W and Sung WL. Three new C19-diterpenoid alkaloids, delbrunine, delbruline and delbrusine from *Delphinium brunonianum* Royle. Heterocycles 1986; 24(4): 873-876.
[96]. Riet-Correa F, Pfister J, Schild AL, Wierenga T. Poisoning by plants, mycotoxins, and related toxins. Cambridge, MA. CAB International 2011: 606-611.
[97]. Welch KD, Cook D, Green BT, Gardner DR, Pfister JA, Mcdaneld TG, Panter KE. Adverse effects of larkspur (Delphinium spp.) on cattle. Agriculture 2015; 5: 456-474.
[98]. Green BT, Gardner DR, Pfister JA, Cook D. Larkspur - poison weed (100 years of *Delphinium* research). Rangelands 2009; 31(1):22-27.
[99]. Al-khateeb E, Al-Ani H, Al-Kadi K, Al-Obaidi EDF, Shalan N and Al-Rawi N. Investigation of the alkaloids of two *Ephedra* Spp. wildly grown in Iraq. Jordan Journal of Pharmaceutical Sciences 2014; 7(3): 191-198.
[100]. Abourashed EA, El-Alfy AT, Khan IA and Walker L. Ephedra in perspective –A current review. Phytother Res 2003;17(7):703–712.
[101]. Al-Snafi AE. Therapeutic importance of *Ephedra alata* and *Ephedra foliata*- A review. Indo Am J P Sci 2017; 4(02): 399-406.
[102]. Cetojevic-Simin DD, Canadanovic-Brunet JM, Bogdanovic GM, Djilas SM, Cetkovic GS, Tumbas VT and Stojiljkovic BT. Antioxidative and antiproliferative activities of different horsetail (*Equisetum arvense* L.) extracts. J Med Food 2010; 13(2): 452-459.
[103]. Al-Snafi AE. The pharmacology of *Equisetum arvense*- A review. IOSR Journal of Pharmacy 2017; 7(2): 31-42.
[104]. Rammal H, Farhan H, Jamaleddine N, El Mestrah M, Nasser M and Hijazi A. Effects of altitude on the chemical composition and on some biological properties of Lebanese *Eryngium creticum* L. Journal of Chemical and Pharmaceutical Research 2015; 7(6):887-893.
[105]. Al-Snafi AE. Chemical constituents and pharmacological effects of *Eryngium creticum*- A review. Indo Am J P Sci 2017; 4(01): 67-73.
[106]. Klvana M, Chen J, Lépine F, Legros R and Jolicoeur M. Analysis of secondary metabolites from *Eschscholzia californica* by high-performance liquid chromatography. Phytochem Anal 2006;17(4): 236-242.
[107]. Cahlíková L, Macáková K, Kunes J, Kurfürst M, Opletal L, Cvacka J, Chlebek J and Blundene G. Acetylcholinesterase and butyrylcholinesterase inhibitory compounds from *Eschscholzia californica* (Papaveraceae). Nat Prod Commun 2010l; 5(7): 1035-1038.
[108]. Park S, Yu M, and Facchini PJ. Antisense RNA-mediated suppression of benzophenanthridine alkaloid biosynthesis in transgenic cell cultures of California poppy. Plant Physiology 2002; 128: 696-706.
[109]. Schumacher HM, Gundlach H, Fiedler F and Zenk MH. Elicitation of benzophenanthridine alkaloid synthesis in *Eschscholtzia* cell cultures. Plant Cell Rep 1987; 6: 410–413.
[110]. Al-Snafi AE. *Eschscholzia californica*: A phytochemical and pharmacological review. Indo Am J P Sci 2017; 4(02): 257-263.

[111]. Byun, SY and Pedersen H. Elicitation and *in situ* recovery of alkaloids in suspension cultures of California poppy. J Microbiol Biotechnol 1991; 1: 220–226.
[112]. Fedurco M, Gregorová J, Šebrlová K, Kantorová J, Peš O, Baur R, Sigel E and Táborská E. Modulatory effects of *Eschscholzia californica* alkaloids on recombinant $GABA_A$ receptors. Hindawi Publishing Corporation Biochemistry Research International 2015, http://dx.doi.org/10.1155/2015/617620
[113]. Gafner S, Dietz BM, McPhail KL, Scott IM, Glinski JA, Russell FE, McCollom MM, Budzinski JW, Foster BC, Bergeron C, Rhyu MR and Bolton JL. Alkaloids from *Eschscholzia californica* and their capacity to inhibit binding of [3H]8-Hydroxy-2-(di-N-propylamino)tetralin to 5-HT1A receptors *in vitro*. J Nat Prod 2006; 69(3): 432-435.
[114]. Křečková M. Biological effect of plant metabolites I. Isolation of alkaloids from *Eschscholzia californica* Cham. (Biologický účinek rostlinných metabolitů I. Izolace alkaloidů z *Eschscholzia californica* Cham.). Diplomová práce 2009.
[115]. Hendriks H, Balraadjsing W, Huizing HJ and Bruins AP. Investigation into the presence of pyrrolizidine alkaloids in *Eupatorium cannabinum* by means of positive and negative ion chemical ionization GC-MS. Planta Med 1987; 53(5):456-461.
[116]. Hendriks H, Malingré TM and Elema ET. Pyrrolizidine alkaloids, flavonoids and volatile compounds in the genus Eupatorium. *Eupatorium cannabinum* L., an ancient drug with new perspectives. Pharm Weekbl Sci 1983; 5(6): 281-286.
[117]. Edgar JA, Lin HJ, Kumana CR and Ng MM. Pyrrolizidine alkaloid composition of three Chinese medicinal herbs, *Eupatorium cannabinum*, *E. japonicum* and Crotalaria *assamica*. Am J Chin Med 1992;20(3-4):281-288.
[118]. Al-Snafi AE. Chemical constituents, pharmacological and therapeutic effects of *Eupatorium cannabinum*- A review. Indo Am J P Sci 2017; 4(01): 160-168.
[119]. Oliveira AP, Silva LR, de Pinho PG, Valentão P, Silva BM, Pereira JA and Andrade PB. Volatile profiling of *Ficus carica* varieties by HS-SPME and GC–IT-MS. Food Chemistry 2010; 123: 548–557.
[120]. Al-Snafi AE. Nutritional and pharmacological importance of *Ficus carica* - A review. IOSR Journal of Pharmacy 2017; 7(3): 33-48.
[121]. Prasad ND, Rao BG, Rao ES, Mallikarjunarao T and Praneet VSD. Quantification of phytochemical constituents and *in vitro* antioxidant activity of *Ficus semicordata* extracts. International Journal of Pharmacy and Pharmaceutical sciences 2012; 4(2): 619-622.
[122]. Tsuda Y, Atta-ur-Rahman, Akhtar MN, Sener B, Parvez M, Sashida Y, Mimaki Y and Mizuno M. The structure of a new crystalline cevane alkaloid: its identity with persicanidine B and harepermine. Nat Prod Res 2004;18(3):205-209.
[123]. Atta-ur-Rahman, Akhtar MN, Choudhary MI, Tsuda Y, Yasin A, Sener B and Parvez M. New diterpene isopimara-7,15-dien-19-oic acid and its prolyl endopeptidase inhibitory activity. Nat Prod Res 2005;19(1):13-22.
[124]. Funda B, BilgeS, Methmet K and Utta Ur Rahman. Steroidal alkaloids of *Fritillaria imperialis* L. Journal of Faculty of Pharmacy of Gazi University 1997; 14(1): 17-23.
[125]. Bailey LH. Manual of Cultivated Plants. MacMillan Company, New York, 1966: 218–219.
[126]. Gilani AH, Shaheen F, Christopoulos A and Mitchelson F. Interaction of ebeinone, an alkaloid from *Fritillaria imperialis*, at two muscarinic acetylcholine receptor subtypes. Life Sci 1997; 60(8):535-544.
[127]. Eglen RM, Harris GC, Cox H, Sullivan AO, Stefanich E and Whiting RL. Characterization of the interaction of the cervane alkaloid, imperialine, at muscarinic receptors *in vitro*. Naunyn-Schmiedeberg's Archives of Pharmacology 1992; 346(2): 144-151.
[128]. Al-Snafi AE. *Fritillaria imperialis*- A review. IOSR Journal of pharmacy 2019, 9(3): 47-51.
[129]. Mir GN and Ghatak BJ. Pharmacological studies on *Fritillaria imperialis*. L Indian J Exp Biol 1966; 4(3): 157-160.
[130]. Chlebek J, Novák Z, Kassemová D, Šafratová M, Kostelník J, Malý L, Ločárek M, Opletal L, Hošt'álková A, Hrabinová M, Kuneš J, Novotná P, Urbanová M, Nováková L, Macáková K, Hulcová D, Solich P, Pérez Martín C, Jun D and Cahlíková L. Isoquinoline alkaloids from *Fumaria officinalis* L. and their biological activities related to Alzheimer's disease. Chem Biodivers 2016; 13(1): 91-99.
[131]. Suau R, Cabezudo B, Rico R,Na´jera F and Lo´pez-Romero JM. Direct determination of alkaloid contents in Fumaria species by GCMS. Phytochem Anal 2002; 13: 363–367
[132]. Rakotondramasy-Rabesiaka L, Havet JL, Porte C and Fauduet H. Solid–liquid extraction of protopine from *Fumaria officinalis* L. Experimental study and process optimization. Separation and Purification Technology 2008; 59(3): 253-261.
[133]. Al-Snafi AE. Constituents and pharmacology of *Fumaria officinalis*- A review. IOSR Journal of Pharmacy 2020; 10(1):17-25.

[134]. Alimova M, Israilov IA, Yunusov MS and Yunusov S. Alkaloids of *Fumaria parviflora*. Chem Nat Compd 1982; 18: 608-609.
[135]. Sousek J, Guedon D, Adam T, Bochorakova H, Taborska E, Valka I and Simanek V. Alkaloids and organic acids content of eight *Fumaria* species. Phytochemical Analysis 1999; 10(1): 6-11.
[136]. Válka I , Walterová D , Popova ME , Preininger V and Šimánek V. Separation and quantification of some alkaloids from *Fumaria parviflora* by capillary isotachophoresis. Planta Med 1985; 51(4): 319-322.
[137]. Popova ME, Šimánek V, Dolejš L, Smysl B and Preininger V. Alkaloids from *Fumaria parviflora* and *F. kralikii*. Planta Med 1982; 45(6): 120-122.
[138]. Forgacs P and Provost J. Presence of rhoeagenine in *Fumaria parviflora.* J Nat Prod 1985; 48 (6): 1000-1001.
[139]. Válka I and Šimánek V. Determination of alkaloids of *Fumaria parviflora* and *Fumaria capreolata* by high-performance liquid chromatography and capillary isotachophoresis 1988;445: 258-263.
[140]. Blaskó G, Hussain SF and Shamma M. (-)-Corlumine, A new phthalide isoquinoline alkaloid from *Fumaria parviflora*. J Nat Prod 1981; 44 (4): 475-477.
[141]. Suau R, Cabezudo B, Rico R,Na´jera F and Lo´pez-Romero JM. Direct determination of alkaloid contents in *Fumaria* species by GC-MS. Phytochem Anal 2002; 13: 363–367.
[142]. Al-Snafi AE. *Fumaria parviflora*- A review. Indo Am J P Sc 2018; 5(3): 1728-1738.
[143]. Abbas MN, Rana SA, Shahid M, Rana N, Mahmood-ul-Hassan M and Hussain M. Chemical evaluation of weed seeds mixed with wheat grains at harvest. The Journal of Animal & Plant Sciences 2012; 22(2): 283-288.
[144]. Al-Snafi AE. Chemical constituents and medical importance of *Galium aparine* - A review. Indo Am J P Sc 2018; 5(3): 1739-1744.
[145]. Doncheva T, Kostova N, Yordanova G, Saadi H, Akrib F, Dimitrov D and Philipov S. Comparison of alkaloid profile from *Glaucium corniculatum* (Papaveraceae) of Algerian and Bulgarian origin. Biochemical Systematics and Ecology 2014; 56: 278-280.
[146]. Al-wakeel SAM, Moubasher MH and Roberts MF. Alkaloids from *Glaucium corniculatum* (l.) of Egyptian origin. Biochemical Systematics and Ecology 1995; 2 (3): 337-338.
[147]. Ghanbarpour A, Shafiee A and Parchami M. Alkaloids of *Glaucium corniculatum*, subspecies refractum, population roodbar. Lioydia 1978; 41(5): 472-475.
[148]. Novak V, Dolejs L and Slavik J. Alkaloids of papaveraceae, XLVIII. (-) ctylopine methohydroxide, a new alkaloid from *Glaucium corniculatum.* Collection Czechoalov Chem Commun 1972; 37: 3346.
[149]. Kintsurashvili LG and Vachnadze VY. Alkaloids of *Glaucium corniculatum* and *G. flavum* growing in Georgia. Chem Nat Compd 2000; 36: 225–226.
[150]. Vorniceanu C, Vatui M, Ionescu A, Zamfirache M and Bara II. Contribution to the chemical study of some papaveraceae species capsules. N.II. *Glaucium flavum*, *Glaucium* and *Chelidonium majus.* https://www.researchgate. net/ publication/ 265408032
[151]. Ghareeb DA, El-Rashidy FH and El-Mallawanyb S. Imbalanced diet deficient in calcium and vitamin D-induced juvenile osteopenia in rats; the potential therapeutic effect of Egyptian moghat roots water extract (*Glossostemon bruguieri*). Iran J Pharm Res 2014; 13(2): 623–634.
[152]. Zain ME, Awaad AS, Al Othman MR and Al-Dosary SK. Antibacterial, antifungal and phytochemical analysis of some desert plants against human pathogenic bacteria and fungi. Life Science J 2010; 11(7): 343-349.
[153]. Al-Snafi AE. Medical importance of *Glossostemon bruguieri* – A review. IOSR Journal of pharmacy 2019; 9(5): 34-39.
[154]. Ayeni MJ, Oyeyemi SD, Kayode J and Peter G P. Phytochemical, proximate and mineral analyses of the leaves of *Gossypium hirsutum* L. and *Momordica charantia* L. Journal of Natural Sciences Research 2015; 5(6): 99-107.
[155]. Al-Snafi AE. Chemical constituents and pharmacological activities of *Gossypium herbaceum* and *Gossypium hirsutum* - A review. IOSR Journal of Pharmacy 2018; 8(5): 64-80.
[156]. Ulubelen A. Alkaloids from *Haplophyllum buxbaumii.* Phytochemistry 1985; 24: 372-374.
[157]. Sheriha GM, Abou Amer K and Elshtaiwi BZ. An alkaloid from *Haplophyllum tuberculatum.* Phytochemistry 1985; 24(4): 884-886.
[158]. McPhail AT, McPhail DR, Al-Said MS, El-Domiaty MM and El- Feraly FS. Revision of stereochemistry of (+)-tuberine, an alkaloid from *Haplophyllum tuberculatum.* Phytochemistry 1990; 29: 3055-3057.
[159]. Al-Rehaily AJ, Al-Howiriny TA, Ahmad MS, Al-Yahya MA, El-Feraly FS, Hufford CD and McPhail AT. Alkaloids from *Haplophyllum tuberculatum.* Phytochemistry 2001; 57(4): 597-602.
[160]. Sheriha GM, Abou Amer KM, Eshtaiwi BZ, Ashour AS, Abed FA and Alhallaq HH. Quinoline alkaloids and cytotoxic lignans from *Haplophyllum tuberculatum*. Phytochemisry 1987; 26(12): 3339-3341.

[161]. Gnan SO and Sheriha GM. Antimicrobial activity of (+)-tuberine. Journal of Food Protection 1986; 49(5): 340-341.
[162]. Khalid SA and Waterman PG. Alkaloid, lignan and flavonoid constituents of *Haplophyllum tuberculatum* from Sudan. Planta Med 1981; 43(2):148-152.
[163]. Al-Yahya MA, Al-Rehaily AJ, Mohammed SA, Mansour S and Farouk S. New alkaloid from *Haplophyllum tuberculatum.* J Nat Prod 1992; 55:899-903.
[164]. Sheriha GM and Abou Amer KM. Lignans of *Haplophyllum tuberculatum.* Phytochemistry 1984; 23 (1): 151-153.
[165]. Al-Snafi AE. Pharmacological importance of *Haplophyllum* species grown in Iraq- A review. IOSR Journal of Pharmacy 2018;8(5): 54-62.
[166]. Machran GH, Hilal SH and El-Alfy TS. The isolation and characterisation of emetine alkaloid from *Hedera helix*. Planta Med 1975; 27(2):127-132.
[167]. Al-Snafi AE. Pharmacological and therapeutic activities of *Hedera helix*- A review IOSR Journal of Pharmacy 2018; 8(5): 41-53.
[168]. Ibrahim TA, Ajongbolo KF and Aladekoyi G. Phytochemical screening and antimicrobial activity of crude extracts of *Basella alba* and *Helianthus annuus* on selected food pathogens. RRJMB 2014; 3(2): 27-31.
[169]. Al-Snafi AE. The pharmacological effects of *Helianthus annuus*- A review. Indo Am J P Sc 2018; 5(3):1745-1756.
[170]. Farrag NM, Abdel-Aziz EM, El-Shafae AM and El Domiaty MM. Pyrrolizidine alkaloids of *Heliotropium bacciferum* Forssk. From Egypt. International Journal of Pharmacognosy 1996; 34(5):374-377.
[171]. Saeedi M and Morteza-Semnani K. Chemical composition and antimicrobial activity of essential oil of *Heliotropium europaeum*. Chemistry of Natural Compounds 2009; 45(1): 98-99.
[172]. Shimshoni JA, Mulder PPJ, Bouznach A, Edery N, Pasval I, Barel S, Abd-El Khaliq M and Perl S. *Heliotropium europaeum* **p**oisoning in **c**attle and **a**nalysis of **i**ts **p**yrrolizidine **a**lkaloid **p**rofile. J Agric Food Chem 2015; *63* (5): 1664–1672.
[173]. Tosun F and Tamer U. Determination of pyrrolizidine alkaloid in the seeds of *Heliotropium europaeum* By GC-MS. Ankara Ecz Fak Derg (J Fac Pharm Ankara) 2004; 33(1):7-9.
[174]. Culvenor CCJ. Alkaloids of *Heliotropium europaeum*. II Isolation and structures of the third major alkaloid and two minor alkaloids and isolations of the principal Noxides. Aust J Chem 1954; 7(3): 287-297.
[175]. Yassa N, Farsam H, Rustaiyan A and Shafiee A. Alkaloids of boraginaceae II [1], pyrrolizidine alkaloids of *Heliotropium europaeum* L. Population Garmsar. Journal of Science, Islamic Republic of Iran 1999; 10: 39-42**.**
[176]. Al-Snafi AE. Pharmacological and toxicological effects of *Heliotropium undulatum* (*H. bacciferum*) and *Heliotropium europaeum*- A review. Indo Am J P Sc 2018; 5 (4): 2150-2158.
[177]. Al-Snafi AE. Chemical constituents, pharmacological effects and therapeutic importance of *Hibiscus rosa-sinensis*- A review. IOSR Journal of Pharmacy 2018; 8 (7): 101-119.
[178]. Okereke CN, Iroka FC and Chukwuma MO. Phytochemical analysis and medicinal uses of *Hibiscus sabdariffa*. International Journal of Herbal Medicine 2015; 2 (6): 16-19.
[179]. Luvonga AW. Nutritional and phytochemical properties of roselle (*Hibiscus sabdariffa*) and sensory evaluation of some beverages made from roselle calyces. MSc thesis. Jomo Kenyatta University of Agriculture and Technology 2012.
[180]. Al-Snafi AE. Pharmacological and toxicological effects of *Heliotropium undulatum* (*H. bacciferum*) and *Heliotropium europaeum*- A review. Indo Am J P Sc 2018; 5 (4): 2150-2158.
[181]. Bourebaba L, Saci S, Touguit D, Gali L, Terkmane S, Oukil N and Bedjou F. Evaluation of antidiabetic effect of total calystegines extracted from *Hyoscyamus albus*. Biomed Pharmacother 2016; 82: 337-344.
[182]. Alghazeer R, El-Saltani H, Saleh N, Al-Najjar A and Hebail F. Antioxidant and antimicrobial properties of five medicinal Libyan plants extracts. Natural Science 2012; 4: 324-335.
[183]. Mobin M, Khan MN and Abbas ZK. Ecotype difference in bioactive constituents and *In vitro* antioxidant activities of some Saudi medicinal plants. European Journal of Medicinal Plants 2015; 7(3):125-136.
[184]. Al-Snafi AE. Therapeutic importance of *Hyoscyamus* species grown in Iraq (*Hyoscyamus albus*, *Hyoscyamus niger* and *Hyoscyamus reticulates*)- A review. IOSR Journal of Pharmacy 2018; 8(6): 18-32.
[185]. El Bazaouia A, Bellimamb A, Lançarc IT and Soulaymania A. Gasliquid chromatography -mass spectrometry investigation of tropane alkaloids in *Hyoscyamus albus* L. from Morocco. Z Naturforsch 2012; 67 c, 461 – 465.
[186]. Medicinal Plants, *Hyoscyamus reticulatus* L,. http://medicinalplants. us/ hyoscyamus -reticulatus-l

[187]. Kartal M, Kurucu S, Altun L, Ceyhan T, Sayar E, Cevheroglu S and Yetkin Y. Quantitative analysis of l-hyoscyamine in *Hyoscyamus reticulatus* L by GC-MS. Turk J Chem 2003; 27: 565-569.
[188]. Moradi B, Delfan B, Hashemi P, Mousavi A and Rahnama H. Matrix solid phase dispersion extraction for tropane alkaloid detection in cultured and collected *Hyoscyamus reticulatus* plants. International Journal of Advanced Research 2015; 3(11): 78 – 82.
[189]. Ionkova I. Alkaloid production of *Hyoscyamus reticulates* plant and transformed root culture clone. Biotechnology & Biotechnological Equipment 1992; 6(2): 50-52.
[190]. Lee IS, Youn UJ, Kim HJ, Min BS, Kim JS and Bae KH. Biphenyl and biphenyl ether quinolizidine N-oxide alkaloids from *Lagerstroemia indica* L. Planta Med 2011; 77:2037–2041.
[191]. Kim HJ, Lee IS, Youn UJ, Chen QC, Ngoc TM, Ha DT, Liu H, Min BS, Lee JY, Seong RS and Bae KH. Biphenyl quinolizidine alkaloids from *Lagerstroemia indica*. J Nat Prod 2009; 72:749-752.
[192]. Ferris JP, Briner RC and Boyce CB. Lythraceae alkaloids. IX. The isolation and structure elucidation of the alkaloids of *Lagerstroemia indica* L. J Am Chem Soc 1971; 93(12): 2958-2962.
[193]. Al-Snafi AE. A review on *Lagerstroemia indica*: A potential medicinal plant. IOSR Journal of Pharmacy 2019; 9(6): 36-42.
[194]. Begum S, Wahab A, Siddiqui BS and Qamar F. Nematicidal constituents of the aerial parts of *Lantana camara*. J Nat Prod 2000; 63(6):765-767.
[195]. Al-Snafi AE. Chemical constituents and pharmacological activities of *Lantana camara*- A review. Asian J Pharm Clin Res 2019; 12912):10-20.
[196]. Jacob PP and Saral AM. Two harmala alkaloids from *Lawsonia inermis* seeds. Chemistry of Natural Compounds 2013; 49(4): 780.
[197]. Al-Snafi AE. A review on *Lawsonia inermis*: A potential medicinal plant. International Journal of Current Pharmaceutical Research 2019; 11(5):1-13.
[198]. Eisenman SW, Zaurov DE and Struwe L (Eds). Medicinal plants of central Asia: Uzbekistan and Kyrgyzstan. Springer, New York, NY, 2013.
[199]. Gresser G, Bachmann P, Witte L and Czygan C. Distribution and taxonomic significance of quinolizidine alkaloids in *Leontice leontopetalum* and *L. ewersmannii* (Berberidacea). Biochemical Systematics and Ecology 1993; 21(6–7): 679-685.
[200]. Al-Snafi AE. Chemical constituents and pharmacological effects of *Lepidium sativum*- A review. International Journal of Current Pharmaceutical Research 2019; 11(6):1-10.
[201]. Priya SE and Ravindhran R. Phytochemical analysis and antimicrobial properties of extracts from aerial parts of *Phyla nodiflora* (L) Greene. Int J Curr Microbiol App Sci 2015; 4(2): 347-358.
[202]. Al-Snafi AE. Anti-inflammatory and antibacterial activities of *Lippia nodiflora* and its effect on blood clotting time. J Thi Qar Sci 2013;4(1):25-30.
[203]. Al-Snai AE. Pharmacological and therapeutic effects of *Lippia nodiflora* (*Phyla nodiflora*). IOSR Journal of Pharmacy 2019; 9(8):15-25.
[204]. Krenn L, Wiedenfeld H and Thomas Roder E. Pyrrolizidine alkaloids from *Lithospermum officinale*. Phytochemistry 1994;37(1):275-277.
[205]. Al-Snafi AE. Chemical constituents and pharmacological effects of *Lithospermum officinale*. IOSR Journal of Pharmacy 2019; 9(8): 12-21.
[206]. Dannhardt G and Steindl L. Alkaloids of Lolium temulentum: isolation, identification and pharmacological activity. Planta Med 1985;(3):212-214.
[207]. Anantharam V, Patanjali SR and Surolia A. A chitotetrose specific lectin from *Luffa acutangula* physico-chemical properties and the assignment of sugars in lectin binding site. Proc Int Symp Biomol Struc 1985; 8: 403-404.
[208]. ManikandaselviS, Vadivel V and Brindha P. Review on *Luffa acutangula* L: Ethnobotany, phytochemistry, nutritional value and pharmacological properties. International Journal of Current Pharmaceutical Review and Research 2016; 7(3); 151- 155.
[209]. Wang K, Sasaki T, Li W, Li Q, Wang YH, Asada Y, Kato H and Koike K. Two novel steroidal alkaloid glycosides from the seeds of *Lycium barbarum*. Chem Biodivers 2011; 8(12): 2277–2284.
[210]. Manayi A, Saeidnia S, Ostad SN, Hadjiakhoondi A, Ardekani MRS, Vaziriana M, Akhtar Y and Khanavi M. Chemical constituents and cytotoxic effect of the main compounds of *Lythrum salicaria* L. Z Naturforsch C 2013;68(9-10): 367-75.
[211]. Piwowarski JP, Granica S and Kiss AK. *Lythrum salicaria* L - underestimated medicinal plant from European traditional medicine- A review. Journal of Ethnopharmacology 2015; 170: 226-250.
[212]. Al-Snafi AE. Chemical constituents and pharmacological effects of *Lythrum salicaria* - A review. IOSR Journal of Pharmacy 2019; 9(6): 51-59.
[213]. Okwu DE and Ezenagu V. Evaluation of the phytochemical composition of mango (*Mangifera indica* Linn) stem bark and leaves. Int J Chem Sci 2008; 6(2): 705-716.

[214]. Al-Snafi AE. Al-Saedy HA , Talab TA, Majid WJ, El-Saber Batiha G, Jafari-Sales Abolfazl. The bioactive ingredients and therapeutic effects of *Marrubium vulgare* - A review. International Journal of Biological and Pharmaceutical Sciences Archive 2021; 1(2):9–21.
[215]. Al-Snafi AE. Khadem HS, Al-Saedy HA, Alqahtani AM, El-Saber Batiha G. Jafari-Sales Abolfazl. A review on *Medicago sativa*: A potential medicinal plant. International Journal of Biological and Pharmaceutical Sciences Archive 2021; 1(2):22-33.
[216]. Salman SM, Ud Din I , Lutfullah G , Shahwar D, Shah Z , Kamran A, Nawaz S and Ali S. Antimicrobial activities, essential element analysis and preliminary phytochemical analysis of ethanolic extract of *Mirabilis jalapa*. International Journal of Biosciences 2015; 7(4): 186-195.
[217]. Al-Snafi AE. Talab TA, Jabbar WM, Alqahtani AM. Chemical constituents and pharmacological activities of *Mirabilis jalapa*- A review International Journal of Biological and Pharmaceutical Sciences Archive 2021; 1(2):34-45.
[218]. Aruna A, Rajeswari PDR, Prabu K, Ramkumar M, Chidambaram R and Sankar SR. Quantitative phytochemical analysis of *Oxalis corniculata* L. (Oxalidaceae). World Journal of Pharmacy and Pharmaceutical Sciences 2014; 3(5): 711-716.
[219]. Pal I, Khaled KL and Datta S. Quantitative estimation of some important minerals in Amrul leaves (leaves of *Oxalis corniculata* Linn) - An underutilized plant. Intern J of Current Res 2015; 7(6): 16765-16767.
[220]. Karakoyun C, Masi M, Cimmino A, Onür1 MA, Somer NU, Kornienko A and Evidente A. A brief up-to-date overview of Amaryllidaceae alkaloids: phytochemical studies of *Narcissus tazetta* subsp. *tazetta* L, collected in Turkey. Natural Product Communications 2019: 1-6.
[221]. Orhan I and Şener B. Sustainable use of various Amaryllidaceae plants against Alzheimer's disease. Proc WOCMAP III. Vol. 4: Targeted Screening of MAPs, Economics & Law. Eds. C Franz, Á Máthé, LE Craker and ZE Gardner. Acta Hort 2005: 678.
[222]. Boit HG, Dopke W. Alkaloide von *Narcissus tazetta* and *N. poeticus* (XIII. Uber Amaryllidaceen-Alkaloide). ChemBer 1956; 89(10): 2462-2465.
[223]. Abdallah OM. Narcisine, an alkaloid from *Narcissus tazetta*. Phytochemistry 1993; 34(5):1447-1448.
[224]. Al-Snafi AE. Constituents and pharmacology of *Narcissus tazetta*. IOSR Journal of Pharmacy 2020; 10(9): 44-53.

Ali Esmail Al-Snafi. "Medicinal plants alkaloids, as a promising therapeutics- A review (Part 1)." *IOSR Journal of Pharmacy (IOSRPHR)*, 11(02), 2021, pp. 51-67.