Vol 5|Issue 4| 2015|321-328.

Asian Journal of Pharmaceutical Science & Technology

www.ajpst.com

e-ISSN: 2248 – 9185
Print ISSN: 2248 – 9177

CHEMICAL CONSTITUENTS AND PHARMACOLOGICAL EFFECTS OF *ASTRAGALUS HAMOSUS* AND *ASTRAGALUS TRIBULOIDES* GROWN IN IRAQ

Ali Esmail Al-Snafi

Department of Pharmacology, College of Medicine, Thi qar University, Nasiriyah, Iraq.

ABSTRACT

Two members of Astragalus genus grown in Iraq, *Astragalus hamosus* and *Astragalus tribuloides*. They possessed a wide range of pharmacological effects. This review highlight the chemical constituents and pharmacological effects of *Astragalus hamosus* and *Astragalus tribuloides*.

Key words: *Astragalus hamosus* and *Astragalus tribuloides*, Biopesticides.

INTRODUCTION

Medicinal plants are the oldest form of healthcare known to mankind. Medicinal plants had been used by all cultures throughout history. Plants are a valuable source of a wide range of secondary metabolites, which are used as pharmaceuticals, agrochemicals, flavors, fragrances, colors, biopesticides and food additives. In the early nineteenth century, many sensitive ingredients were isolated and introduced in the medical practice [1-54]. Astragalus L., is one of the largest genuses of flowering plants in the Leguminosae family. As annual or perennial herbs, subshrubs, or shrubs, the plants of Astragalus L. are widely distributed throughout the temperate and arid regions. So far, the genus has been estimated to contain 2000–3000 species and more than 250 taxonomic sections in the world [55-56]. Two members of Astragalus genus grown in Iraq, *Astragalus hamosus* and *Astragalus tribuloides*. This sreview was designed to highlight the chemical constituents and pharmacological effects of *Astragalus hamosus* and *Astragalus tribuloides*.

Astragalus hamosus

Synonyms

Ankylobus hamosus (L.) Steven, *Astragalus aegyptiacus* Mill., *Astragalus ancistron* Pomel, *Astragalus arnoceras* Bunge, *Astragalus brachyceras* Ledeb., *Astragalus buceras* Willd., *Astragalus dorcoceras* Bunge, *Astragalus embergeri* Jahand. & al., *Astragalus hamosus* L. var. ancistron (Pomel)Batt., *Astragalus hamosus* L. subsp. brachyceras (Ledeb.)Batt., *Astragalus hamosus* L. var. brachyceras (Ledeb.) Ledeb., *Astragalus hamosus* L. var. brevipes Lange, *Astragalus hamosus* L. var. brevipes Faure & Maire, *Astragalus hamosus* L. var. buceras (Willd.)Rouy, *Astragalus hamosus* L. subsp. embergeri (Jahand. & al.)Maire, *Astragalus hamosus* L. var. macrocarpus DC., *Astragalus hamosus* L. var. microcarpus Zohary, *Astragalus hamosus* L. var. multiflorus Griseb., *Astragalus hamosus* L. var. pumilus Parsa, *Astragalus hamosus* L. var. subcurvatus Pau ,*Astragalus hamosus* L. subsp. verus Emb. & Maire, *Astragalus hamosus* L. var. volubilitanus (Braun-Blanq. & Maire)Maire, *Astragalus oncocarpus* Pomel, *Astragalus paui* Pau, *Astragalus stribrnyi* Velen., *Astragalus taeckholmianus* Oppenh. ,*Astragalus volubilitanus* Braun-Blanq. & Maire, *amosa astragalus* Medik., *Tragacantha brachyceras* (Ledeb.) Kuntze , *Tragacantha buceras* (Willd.) Kuntze, *Tragacantha hamosa* (L.) Kuntze [57-59].

Taxonomic classification

Kingdom: Plantae, Subkingdom: Tracheobionta, Superdivision: Spermatophyta, Division: Magnoliophyta, Class: Magnoliopsida, Subclass: Rosidae, Order: Fabales, Family: Fabaceae (alt. Leguminosae), Subfamily: Faboideae, Tribe: Galegeae, Subtribe: Astragalinae, Genus: Astragalus, Species: *Astragalus hamosus* [60-61].

Common names

Arabic: Iklil el malik, Adhafer el Shitan, Kethera, , Krena; English: Tonkin bean, Melilot, King's rown, King's clove, Hook-pod milk-vetch, Yellow milk-vetch, European

Corresponding Author**: Ali Esmail Al-Snafi** E-mail: aboahmad61@yahoo.com

milkvetch; Hawaiian**:** Purtuk; Italian: Meliloto Falso; Russian:Astragal Kryuchkonosnyi [61-62].

Distribution

It was distributed from North Western Africa to Asia [57]. The plant nowadays is found in Africa: Algeria, Egypt, Libya, Morocco, Tunisia; Asia: Armenia, Azerbaijan, Gruzia, Iran, Iraq, Pakistan, Russia in Asia, Turkmenistan, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey in Asia, United Arab Emirates; Australasia: Australia; Europe: Albania, Bulgaria, Corsica, Crete, former Yugoslavia, France, Great Britain, Greece, Hungary, Italy, Malta, Portugal, Romania, Russia in Europe, Sardinia, Spain, Turkey in Europe, Ukraine; North America: United States [57,61].

Traditional uses

The plant was used as demulcent, emollient, galactogogue and laxative. It was also used in treating irritation of the mucous membranes, nervous affections and catarrh. Young seedpods were used in salads [63-67]. It is described to possess anti- inflammatory effect and is used as an anti- inflammatory agent by Unani physicians in various inflammatory disorders [68].

Description

Herbs, undershrubs or shrubs. Leaf paripinnate or imparipinnate, rarely unifoliolate or digitately trifoliolate; leaflets entire, stipels absent; stipulate. Inflorescence racemose, spicate umbellate or solitary; peduncles generally axillary. Flowers bracteate; bracteoles present or absent; pedicellate or sessile, violet or purple to white or pale yellow. Calyxtubular, teeth subequal. Vexillum ovate, obovate, oblong, panduriform or sometimes appendiculate Wing and keel generally with long claws. Stamens diadelphous, vexillary stamen free, anthers uniform. Ovary sessile or stipitate, glabrous or pubescent; style straight or incurved, stigma mostly terminal , some times penicillate. Fruitsessile or stipitate, 2-valved, unilocular, partly or completely bilocular by an intrusive membrane. Seed often reniform [62].

Part used : The primary medicinal parts of the herb were the roots. Seed pod are edible[26].

Chemical constituents

The callus of the plant contained amino acids, the roots contained saponins and sterols. The leaves yield 3-nitropropionic acid [69]. The plant contained flavonols including hyperoside, isoquercitrin, astragalin and rhamnocitrin 4'-beta-D-galactopyranoside[70].

The composition of the volatile substances (% of the total volatiles) at the stage of leaf development in *Astragalus hamosus* were: alcohols (total) 0% (1-butanol, 2,3-butanediol 1,3, butanediol, 3-hexen-1-ol, 2-hexen-1-ol, 1-hexanol, 1-octen-3-ol, 3-ethyl-4-methylpentan-1-ol, benzyl alcohol, eugenol, 2-methoxy-4-vinyl phenol). Aldehydes 0 % (nonanal, decanal, ketones, 3-methyl-2(2-pentenyl)-2 -cyclopenten-1-one). Acids 0.3% (nonanoic acid 0.1% , tetradecanoic acid 0.1% , pentadecanoic acid 0%, hexadecanoic acid 0.1%). Esters 2.1% (3-hexen-1-ol acetate 0% , 2,3-butanediol diacetate 0% , hexadecanoic acid methyl ester 0%, (18:1)-methyl ester 0%, glycerol tricaprylate 2.1%). Ethers 0% (2-ethoxybutane, 1-ethoxybutane, 1,1-diethoxyethane). Hydrocarbons 14.9% (heptane 0.1%, heptadecane 0% , ctadecane 0% , nonadecane 0.1% , eicosane 0% , docosane 0% , pentacosane 0% , hexacosane 2.1%, heptacosane 3.9%, octacosane 2.1% , onacosane 3.2%, triacontane 0%, dotriacontane 0%, hentriacontane 0%, docosene 3.4%, squalene 0%). Aromatic hydrocarbons 0%, phenanthrene 0%, terpenes 10.1% (linalool 0%, 2-terpineol 0%, geraniol (nerol) 0%, hexahydrofarnesyl acetone 0.1%, phytol 10.0%). Others 0% (Isobutyl-isothiocyanate, 2,3-Dihydro benzofurane). However, the composition of the volatile substances (% of the total volatiles) at the stage of flowering in *Astragalus hamosus* were : Alcohols (total) 1.5% (1,3-butanediol 1.0% , 2,3-butanediol 0.2%, 2-hydroxy-6,10-dimethyl-5,9-undecadien 0%, 2-Methoxy-3-(2-propenyl) phenol 0%, 2-phenyl phenol 0.3%). Aldehydes 0.7 % (hexanal 0.2%, heptanal 0%, nonanal 0.3%, decanal 0.2%) . Acids 18.1% (octanoic acid 0.3%, butanedioic acid 0.2%, nonanoic acid 0.3% , decanoic acid 0.2% , dodecanoic acid 0.8%, tetradecanoic acid 0%, hexadecanoic acid 16.3%). Ethers 0.1% (2-ethoxybutane 0.1%). Esters 0.2% (hexanedioic acid ethylhexyl diester 0.1%, hexadecanoic acid hexadecyl ester 0.1%, isopropyl myristate 0.2%, hexadecanoic acid methyl ester 0.2%). Amines 0% (N-butyl-1-butanamine). Amides 0.4% (N,N-dibutyl-formamide 0.4%), halogenated compounds (1,3-dichloro-2-propanone, 1,3-dichloro-2-propanol, hydrocarbons 26.1%, heptane 0.3%, cyclotetradecane 0%, pentadecane 0.3%, hexadecane 0%, heptadecane 0%, 4,11-dimethyl pentadecane 0%, octadecane 0%, nonadecane 0.1%, eicosane 1.7%, heneicosane 0%, 2-methyl eicosane 0%, docosane 0%, tricosane 0%, tetracosane 1.9%, pentacosane 4.2%, hexacosane 2.0%, heptacosane 5.3%, octacosane 2.2%, onacosane 8.0%, triacontane 0.1%, hentriacontane 0%, dotriacontane 0%, squalene 0%). Terpenes 6.3% (linalool 0%, hexahydrofarnesyl acetone 3.2%, phytane 0% and phytol 3.1%) [71]. Flavonol glycoside 7-O-methyl-kaempferol 4'-beta-D-galactopyranoside (rhamnocitrin 4'-beta-D-galactopyranoside), isoquercitrin and astragalin were isolated from *Astragalus hamosus* [72].

Pharmacological effects

Astragalus has a wide range of potential therapeutic applications in immunodeficiency syndrome, as an adjunct cancer treatment, and for its adaptogenic effect on the heart and kidneys. When ligusticum combined with astragalus, they have exerted a notable immunopotentiating

effect. They were included in many classic Chinese formulations, astragalus was also part of the Japanese and Korean herbal formularies [72].

Antiinflammatory analgesic effects

Astragalus hamosus pod extract showed anti-inflammatory activity , it induced significant reduction in the size of rats' hind paws 3 hours after injection. The aqueous and alcoholic extracts of the pod exhibit a similar significant effect [68].

The anti-inflammatory effect of the hydro-alcoholic extract of the pods of *Astragalus hamosus* (HAAH)was evaluated by the rat paw edema induced by formalin. Also the analgesic effect was examined by the acetic-acid-induced writhing response and hot plate test. The analgesic effects of chloroform, hexane, ethyl acetate and aqueous fractions were evaluated by the hot-plate method. The hydroalcoholic extract of *Astragalus hamosus* could reduce the edema in a dose-dependent manner ($P<0.05$). In the acute phase, the result of 1000 mg/Kg and in the chronic phase, the result of 100 and 300 mg/Kg of the extract were more significant and comparable with the effect of sodium salicylate. Also application of different doses of HAAH had significant anti-nociceptive effects on both animal models. The findings showed that HAAH at doses of 700 and 1000 mg/Kg produced analgesic effects comparable to sodium salicylate. The hexane and ethyl acetate (but not the other fractions) showed significant analgesic activity in hot plate test, when compared to morphine [74]. An aqueous and alcoholic extract of *Astragalus hamosus* (0.58 gm/kg) once a day for 13 days, orally produced highly significant anti-inflammatory effect in comparison to the control [68].

In the evaluation of the anti-viral effect of emodin plus astragalus polysaccharide (APS) in hepatitis B virus (HBV) transgenic mice , emodin and astragalus had a weak but persistent inhibitory effect on HBV replication in mice which may function as a supplementary modality in the treatment of hepatitis B infection. After 21 day of treatment with physiological saline containing (emodin and astragalus, 57.59 and 287.95 mg/kg per day, respectively), HBV DNA levels was significantly declined when compared with normal control group . A reduction in the contents of HBsAg, HBeAg and HBcAg in the mice was observed when compared with normal control group [75]..

Antioxidant and cytotoxic effects

Pharmacological evaluations have shown antioxidant activity of methanolic extract of *Astragalus hamosus* [76].

The hepatoprotective activity of flavonoid rhamnocitrin 4'-β-D-galactopyranoside (RGP) obtained from leaves of *Astragalus hamosus* L. was studied against N-diethylnitrosamine (DENA)-induced hepatic cancer in Wistar albino rats. Hepatic cancer in rats was induced by single-dose intraperitoneal administration of DENA (200 mg/kg). Induction of hepatic cancer was confirmed after 7 days of DENA administration by measurement of elevated level of serum α-feto protein (AFP). Administration of DENA in a single dose lofted the levels of serum biochemical parameters like alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, total bilirubin, total protein and AFP. Antioxidant enzymes like superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), glutathione-S-transferase (GST) and lipid per oxidation (LPO) were annealed significantly by administration of RGP in a dose-dependant manner. The histopathological examination of rat liver section was found to reinforce the biochemical observations significantly. It was observed that a substantial and dose-dependent reversal of DENA-diminished activity of antioxidant enzymes like SOD, CAT, GPx, GST and the reduced DENA-elevated level of LPO with a marked change. Any elevation in the levels of serum markers along with suppression of free radical formation by scavenging the hydroxyl radicals is significantly prevented by RGP. It also modulates the levels of LPO and perceptibly increases the endogenous antioxidant enzymes level in DENA-induced hepatocellular carcinogenesis [77].

The purified saponin mixture from *A. hamosus* cytotoxicity was evaluated against a panel of human tumor cell lines. The saponin mixture demonstrated significant antiproliferative effects against a multi-drug resistant cell line HL-60/Dox, with a collateral sensitivity phenomenon, i.e. the IC_{50} value was lower in the resistant sub-line in comparison with the chemosensitive parent cell line HL-60 [70].

Evaluation of ant proliferative effect of a flavonol glycoside and saponins of *Astragalus hamosus* by MTT-dye reduction assay showed concentration-dependent inhibition of malignant cell proliferation by saponins, while the flavonoid exerted only marginal effects [78].

The anticancer activity of dinaline (histone deacetylase inhibitor), decitabine (DNA methylation inhibitor), erufosine (alkylphoshpcholine derivate), tamoxifen (estrogen modulator) were compared with the isolated mixture of two saponins,derived from *Astragalus hamosus*, L. (Fabaceae) in two breast carcinoma cell lines MCF-7 estrogen receptor (ER) positive and MDA-MB 231 - ER negative. The study confirmed the antineoplastic activity of the saponin mixture, derived from *Astragalus hamosus*, which were previously found to be active against human leukemia cells. Moreover, the saponin mixtureshowed dramatic decrease in the expression level of the mitochondrial protein BclxL, which outlines its special influence on the cell death signal transduction and suggests a probable mechanism of action [79].

Volatile compounds of this plant showed significant cytotoxic activity against human acute lymphoid leukemia in concentration dependent manner [80].

Neural and hepatic protective effects

The hepatoprotective activity of flavonoid rhamnocitrin 4'-β-D-galactopyranoside (RGP) obtained from leaves of *Astragalus hamosus* L. was documented against N-diethylnitrosamine (DENA)-induced hepatic cancer in Wistar albino rats [77].

The effects of rhamnocitrin 4-β-D-galacto pyranoside (RGP), isolated from *A. hamosus* were evaluated on isolated rat brain synaptosomes, prepared by Percoll reagent and on rat hepatocytes, isolated by two-stepped collagenase perfusion. In synaptosomes, RGP had statistically significant protective effect, similar to those of silymarin, on 6-hydroxy (OH)-dopamine-induced oxidative stress. These results correlate with the protective effects of kempferol and rhamnocitrin on oxidative damage in rat pheochromocytoma PC12 cells. In rat hepatocytes, the effect of RGP on two models of liver toxicity: Bendamustine and cyclophosphamide showed that the compound had statistically significant cytoprotective and antioxidant activity, similar to those of silymarin [81].

Contraindication and adverse effects

The LD_{50} of Astragalus is approximately 40g/kg when administered by intraperitoneal injection to rats. Overall it is very safe and doses as high as 100g/kg of the raw herb have been given to rats by lavage with no adverse effects [82]. However, water extracts of *A. hamosus* leaves were toxic to chicks at the equivalent of 3 g of dried plant per chick, and lethal at 6 to 8 g [83].

Astragalus tribuloides

Synonym

Astragalus kirghisicus Stschegl., *Astragalus tribuloides* Delile variety leiocarpus Boiss., *Astragalus tribuloides* var. leiocarpus Boiss [84-85].

Taxonomic classification

Kingdom: Plantae; Phylum: Tracheophyta; Class: Magnoliopsida; Order: Fabales; Family: Fabaceae; Genus: Astragalus L; Species: *Astragalus tribuloides* Delile [69, 86].

Common names

Arabic: Khazna, Jerna,Kufaia, Rukhami, **English:** Locoweed [26].

Distribution

It was widely distributed in the South Eastern Mediterranean area and temperate and tropical Asia. It was native in Afghanistan, Algeria, Armenia, Azerbaijan, Bahrain, China, Egypt, India, Iran, Iraq, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Libya, Morocco, Oman, Pakistan, Qatar, Syrian, Tajikistan, Tunisia, Turkey, Turkmenistan, United Arab Emirates, Uzbekistan, and Yemen [85, 87-91].

Traditional use

The herb was used as emollient and demulcent [91]. In the Chinese medical system, astragalus affects both the spleen and the lung meridians. It was indicated for spleen deficiency symptoms such as diarrhea, fatigue, spontaneous sweating, and lack of appetite. Astragalus tonifies the lungs and was used in cases of frequent colds and shortness of breath [92]. Other traditional indications include wasting disorders and night sweats [93].

Description

Plant with appressed to ascending white hairs 0.2-1.5 mm. Stems from nearly absent to 40 cm, prostrate to ascending, hairy. Leaves 1.5-7 cm; stipules membranous, 2-3 mm, hairy; petiole 0.5-2 cm, like rachis hairy; leaflets in 4-10 pairs, nar-rowly elliptic, 2.5-15 × 0.8-4 mm, both surfaces sericeous with appressed hairs, apex acute. Racemes sessile, rarely with a pe-duncle up to 2.5 cm, (1 or)2-8-flowered; bracts membranous, 1-3 mm. Calyx tubular, 3-5 mm, densely hairy; teeth 1-2 mm. Petals whitish or white suffused with mauve or pink; standard narrowly oblong, 4-10 × 1.2-2.5 mm, apex retuse; wings 4-6 mm; keel 3-5 mm. Legumes mostly starlike spreading, straight or slightly curved, oblong-triangular, 4-12 mm, 2.5-4 mm high and wide, distinctly bigibbous at base, acute at apex, with a deep dorsal groove widened at base; valves with short appressed hairs 0.05-0.15 mm and with much longer appressed to subappressed hairs up to 1.5 mm [94].

Part used: The primary medicinal parts of the herb were the roots [26].

Chemical constituents

Astragalus genus contained many compounds , these included : polysaccharides and triterpenoid saponins from the root: astragalans, astraglucans, astragalosides I – IV and trigonosides I-III. Flavonoids were isolated from the root including afromormosin, calycosin and odoratin. Indolizidine alkaloids, aliphatic nitro compounds, selenium, and biogenic amines such as g-aminobutyric acid (GABA, 0.024%) , and tragacanthin or tragacanth gum were also isolated from the plant [95].

Pharmacological effets

Astragalus has a wide range of potential therapeutic applications in immunodeficiency syndrome, as an adjunct cancer treatment, and for its adaptogenic effect on the heart and kidneys [96-99].

Astragalus injection was effective in lowering β(2)-microglobulin , microalbuminuria compared with placebo, and it was also superior to prostaglandin in lowering blood urea nitrogen, creatinine clearance rate. There were no adverse effects reported in the trials from astragalus injection [100].

It can grow adequately in both seliniferous and non-seliniferous soils, and can contain up to 1000 ug Se g^{-1} dry matter [101-102]. Selenium is an essential element for all animals and humans. The US recommended dietary

allowance is 55–70 ug d^{-1} and the UK reference nutrient intake is 60–70 ug/d. However, human diets in several countries lack sufficient Se**.** To address this dietary Se deficiency, agronomists and plant breeders are pursuing two complementary strategies to develop crops**.** with enhanced Se content. The first strategy is through improvements in crop husbandry. For this strategy , it was important to determine the potential for different crops to accumulate Se. The second strategy was to develop crop genotypes with improved Se accumulation and tolerance traits [103-106] .

Selenium has an important role in cellular antioxidant defenses as a necessary component of selenoproteins. Selenium is incorporated into selenoproteins as selenocysteine. The glutathione (GSH) peroxidases are the best-characterized selenoproteins, although other circulating selenoproteins also have antioxidant functions.

In laboratory animals, parenteral administration of organic and inorganic selenium (210 to 12,000 ug/kg) has been shown to protect against anticancers toxicity [107].

Contraindications and Side effects

Allergic reactions in rare cases [108].

Dosage

Liquid; astragalus extract 1:3 (equiv. of 330mg of astragalus herb in 1ml) [109].

CONCLUSION

This review discussed the chemical constituents and pharmacological effects of *Astragalus hamosus* and *Astragalus tribuloides* , the members of Astragalus genus grown in Iraq.

REFERENCES

1. Kadir MA, Al-Snafi AE and Farman NA. Comparison between the efficacy of sulpher and garlic in treatment of scabies. *The Med J Tikrit University*, 5, 1999, 122-125.
2. Al-Snafi AE. Central nervous and endocrine effects of Myristica fragrans. 4th Arabic Conf. of Medicinal plants. Thamar Univ. Yemen, 1999, 111-121 .
3. Al-Snafi AE. The Methods followed by Arabic physicians for treatment of cancer 4th Arabic conf . of Medicinal plants. Thamar Univ, Yemen 1989.
4. Al-Snafi AE. The miraculous nature of the prophet medicine: Analytical study. Al Diaa Publication house, Iraq, 2009.
5. Al-Snafi AE, Al-Trikrity AH and Ahmad RH. Hypoglycemic effect of *Teucrium polium* and *Cyperus rotundus* in normal and diabetic rabbits. *The Med J Tikrit University*, 9(2), 2003, 1-10.
6. Al-Snafi AE. The therapeutic importance of *Cassia occidentalis* - An overview. *Indian Journal of Pharmaceutical Science & Research*, 1(3), 2015, 158-171.
7. Marbin M Ideen and Al-Snafi AE. The probable therapeutic effects of Date palm pollens in treatment of male infertility. *Tikrit journal of Pharmaceutical Sciences*, 1(1), 2005, 30-35.
8. Al-Snafi AE, Adbul Ghani M Al-Samarai and Mahmood Al-Sabawi. The effectiveness of *Nigella sativa* seed oil in treatment of chronic Urticaria. *Tikrit Journal of Pharmaceutical Sciences*, 1(1), 2005, 19-26.
9. Al-Snafi AE and Talib Razaq Museher. Hypnotic, muscle relaxant, and anticonvulsant effects of *Myristica fragrans*. *Thi-Qar Medical Journal*, 2(1), 2008, 18-23.
10. Al-Snafi AE. Chemical constituents and pharmacological activities of *Ammi majus* and *Ammi visnaga*. A review. *International Journal of Pharmacy and Industrial Research*, 3(3), 2013, 257-265.
11. Al-Snafi AE. Pharmacological Effects of *Allium* Species Grown in Iraq. An overview. *International Journal of Pharmaceutical and health care Research*, 1(4), 2013, 132-147.
12. Al-Snafi AE. Chemical constituents and pharmacological activities of Milfoil (*Achillea santolina*) - A Review. *Int J Pharm Tech Res*, 5(3), 2013, 1373-1377.
13. Al-Snafi AE. The Pharmaceutical importance of *Althaea officinalis* and *Althaea rosea*: A Review. *Int J Pharm Tech Res*, 5(3), 2013, 1387-1385.
14. Al-Snafi AE. Anti-inflammatory and antibacterial activities of *Lippia nodiflora* and its effect on blood clotting time. *J Thi Qar Sci*, 4(1), 2014, 25-30.
15. Al-Snafi AE. The pharmacology of *Bacopa monniera*. A review. *International Journal of Pharma Sciences and Research*, 4(12), 2013, 154-159.
16. Al-Snafi AE. The Pharmacological Importance of Bauhinia variegata. A Review. *Journal of Pharma Sciences and Research*, 4(12), 2013, 160-164.
17. Al-Snafi AE. The pharmacological importance of *Benincasa hispida*. A review. *Int Journal of Pharma Sciences and Research*, 4(12), 2013, 165-170.
18. Al-Snafi AE. The chemical constituents and pharmacological effects of *Bryophyllum calycinum*. A review. *Journal of Pharma Sciences and Research*, 4(12), 2013, 171-17
19. Al-Snafi AE. The pharmacological activities of *Alpinia galangal* - A review. *International Journal for Pharmaceutical Research Scholars*, 3(1-1), 2014, 607-614.

20. Al-Snafi AE. Chemical constituents and pharmacological activities of *Arachis hypogaea*. – A review. *International Journal for Pharmaceutical Research Scholars*, 3(1-1), 2014, 615-623.
21. Al-Snafi AE. The pharmacological importance and chemical constituents of *Arctium Lappa*. A Review. *International Journal for Pharmaceutical Research Scholars*, 3(1-1), 2014, 663-670.
22. Al-Snafi AE. The pharmacology of *Apium graveolens.* - A review. *International Journal for Pharmaceutical Research Scholars*, 3(1-1), 2013, 671-677.
23. Al-Snafi AE. The pharmacology of *Anchusa italica* and *Anchusa strigosa* – A review. *International Journal of Pharmacy and Pharmaceutical Sciences*, 6(4), 2014, 7-10.
24. Al-Snafi AE. The pharmacological importance of *Anethum graveolens* – A review. *International Journal of Pharmacy and Pharmaceutical Sciences*, 6(4), 2014, 11-13.
25. Al-Snafi AE. The chemical constituents and pharmacological importance of *Carthamus tinctorius* - An Overview. *Journal of Pharmaceutical Biology*, 5(3), 2006, 143-166.
26. Al-Snafi AE. Encyclopedia of the constituents and pharmacological effects of Iraqi medicinal plants. Thi qar University, 2013.
27. Al-Snafi AE, Wajdy JM and Tayseer Ali Talab. Galactagogue action of *Nigella sativa* seeds. *IOSR Journal of Pharmacy*, 4(6), 2014, 58-61.
28. Al-Snafi AE. The chemical constituents and pharmacological effects of *Adiantum capillus-veneris* - A review. *Asian Journal of Pharmaceutical Science and Technology*, 5(2), 2015, 106-111.
29. Al-Snafi AE. The pharmacological and therapeutic importance of *Agrimonia eupatoria*- A Review. *Asian Journal of Pharmaceutical Science and Technology*, 5(2), 2015, 112-117.
30. Al-Snafi AE. The chemical constituents and pharmacological effects of *Ammannia baccifera* - A review. *International Journal of Pharmacy*, 5(1), 2015, 28-32.
31. Al-Snafi AE. The chemical contents and pharmacological effects of *Anagallis arvensis* - A review. *International Journal of Pharmacy*, 5(1), 2015, 37-41.
32. Al-Snafi AE, Raad M. Hanaon, Nahi Y. Yaseen, Wathq S. Abdul alhussain. Study the anticancer activity of plant phenolic compounds. *Iraqi Journal of Cancer & Medical Genetics*, 4(2), 2011, 66-71.
33. Al-Snafi AE. The pharmacological importance of *Artemisia campestris*- A review. *Asian Journal of Pharmaceutical Research*, 5(2), 2014, 88-92.
34. Al-Snafi AE. Chemical constituents and pharmacological effects of *Asclepias curassavica* – A review. *Asian Journal of Pharmaceutical Research*, 5(2), 2015, 83-87.
35. Al-Snafi AE. The pharmacological importance of *Asparagus officinalis* - A review. *Journal of Pharmaceutical Biology*, 5(2), 2015, 93-98.
36. Al-Snafi AE. The medical importance of *Betula alba* - An overview. *Journal of Pharmaceutical Biology*, 5(2), 2015, 99-103.
37. Al-Snafi AE. Bioactive components and pharmacological effects of *Canna indica*- An Overview. *International Journal of Pharmacology and toxicology*, 5(2), 2015, 71-75.
38. Al-Snafi AE. The chemical constituents and pharmacological effects of *Capsella bursa-pastoris* - A Review. *International Journal of Pharmacology and toxicology*, 5(2), 2015, 76-81.
39. Al-Snafi AE. The pharmacological importance of *Ailanthus altissima*- A review. *International Journal of Pharmacy Review and Research*, 5(2), 2015, 121-129
40. Al-Snafi AE. *Alhagi maurorum* as a potential medicinal herb: An Overview. *International Journal of Pharmacy Review and Research*, 5(2), 2015, 130-136.
41. Al-Snafi AE. The pharmacological importance of *Aloe vera*- A review. *International Journal of Phytopharmacy Research*, 6(1), 2015, 28-33.
42. Al-Snafi AE. The constituents and biological effects of *Arundo donax* - A review. *International Journal of Phytopharmacy Research*, 6(1), 2015, 34-40.
43. Al-Snafi AE. The nutritional and therapeutic importance of *Avena sativa* - An Overview. *International Journal of Phytotherapy*, 5(1), 2015, 48-56.
44. Al-Snafi AE. The Pharmacological Importance of *Bellis perennis* - A review. *International Journal of Phytotherapy*, 5(2), 2015, 63-69.
45. Al-Snafi AE. The chemical constituents and pharmacological effects of *Capparis spinosa* - An overview. *Indian Journal of Pharmaceutical Science and Research*, 5(2), 2015, 93-100.
46. Al-Snafi AE. The chemical constituents and pharmacological effects of *Carum carvi* - A review. *Indian Journal of Pharmaceutical Science and Research*, 5(2), 2015, 72-82.
47. Al-Snafi AE. The pharmacological importance of *Casuarina equisetifolia* - An Overview. *International Journal of Pharmacological Screening Methods*, 5(1), 2015, 4-9.

48. Al-Snafi AE. The chemical constituents and pharmacological effects of *Chenopodium album* - An overview. *International J of Pharmacological Screening Methods*, 5(1), 2015, 10-17.
49. Al-Snafi AE, Yaseen NY and Al-Shatry MM. Anticancer effects of sodium valproate. *International Journal of Pharmtech Research*, 7(2), 2015, 291-297.
50. Al-Snafi AE, The effect of date palm pollens and zinc sulphate in the treatment of human male infertility. *Tikrit Journal of Pharmaceutical Sciences*, 2(1), 2006, 31-34.
51. Al-Snafi AE. Pharmacology and medicinal properties of *Caesalpinia crista* - An overview. *International Journal of Pharmacy*, 5(2), 2015, 71-83.
52. Al-Snafi AE. The chemical constituents and pharmacological effects of *Calendula officinalis* - A review. *Indian Journal of Pharmaceutical Science & Research*, 5(3), 2015, 172-185.
53. Al-Snafi AE. The constituents and pharmacological properties of *Calotropis procera* - An Overview. *International Journal of Pharmacy Review & Research*, 5(3), 2015, 259-275.
54. Al-Snafi AE. The pharmacological importance of Capsicum species (*Capsicum annuum* and *Capsicum frutescens*) grown in Iraq. *Journal of Pharmaceutical Biology*, 5(3), 2015, 124-142.
55. Podlech D. The genus Astragalus L. (Fabaceae) in Europe with exclusion of the former Soviet Union. *Feddes Repertor*, 119, 2008, 310-387.
56. Benchadi W, Haba H, Lavaud C, Harakat D and Benkhaled M. Secondary metabolites of *Astragalus cruciatus* Link. and their chemotaxonomic significance. Rec Nat Prod, 7, 2013, 105-113.
57. http://www.ildis.org/LegumeWeb?version~
58. Gontscharov NF and Popov MG. In: Flora USSR, Mosqua, Leningrad, 1946.
59. Podlech D. Comments on Galegeae - European. Report produced for ILDIS, 1996.
60. http://plants.usda.gov/core/profile?symbol=ASHA13
61. http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl
62. ZipcodeZoo.com, *Astragalus hamosus*, zipcodezoo.com/Plants/A/Astragalus_ hamosus/
63. *Astragalus hamosus*, http://practicalplants.org/wiki /Astragalus _hamosus
64. Hedrick UP. Sturtevant's Edible Plants of the World. Dover Publications, 1972.
65. Tanaka T. Tanaka's Cyclopaedia of Edible Plants of the World. Keigaku Publishing, 1976.
66. Kunkel G. Plants for Human Consumption. Koeltz Scientific Books, 1984.
67. Chopra RN, Nayar SL and Chopra IC. Glossary of Indian Medicinal Plants. Council of Scientific and Industrial Research, New Delhi, 1986.
68. Hakim A, Tajuddin G A and Nasreen J. Evaluation of anti-inflammatory activity of the pods of Iklil-ul-Malik (*Astragalus hamosus* Linn.). *Ind J Nat Prod Resour*,1, 2010, 34–37.
69. Khare CP. Indian-Medicinal-Plants- An-Illustrated dictionary. Springer Science and Business Media, LLC, 2007, 71.
70. Krasteva I, Platikanov S, Nikolov S, and Kaloga M. Flavonoids from *Astragalus hamosus*. *Nat Prod Res*, 21(5), 2007, 392-395.
71. Platikanova S, Nikolov S, Pavlova D, Evstatieva L, and Popov S. Volatiles from four *Astragalus* species: Phenological changes and their chemotaxonomical application. *Z Naturforsch*, 60c, 2005, 591-599.
72. Krasteva I, Platikanov S, Nikolov S and Kaloga M. Flavonoids from *Astragalus hamosus*. *Nat Prod Res*, 21(5), 2007, 392-395.
73. Sinclair S. Chinese Herbs: A clinical review of Astragalus, Ligusticum, and Schizandrae. *Altern Med Rev*, 3(5), 1983, 338-344.
74. http://ijpr.sbmu.ac.ir/article_1620_0.html
75. Dang SS, LiJia X, Cheng YA, Zhang X, Sun MZ, and Liu EQ. Inhibitory effect of emodin and Astragalus polysaccharide on the replication of HBV. *World J of Gastroenterology*, 15(45), 2009, 5669.
76. Souri E, Amin G and Farsam H. Screening of antioxidant activity and phenolic content of 24 medicinal plant extracts. *Daru J Pharm Sci*, 16, 2008, 83-87.
77. Saleem S, Shaharyar MA, Khusroo MJ, Ahmad P, Rahman RU, Ahmad K, Alam MJ, Al-Harbi NO, Iqbal M and Imam F. Anticancer potential of rhamnocitrin 4'-β-D-galactopyranoside against N-diethylnitrosamine-induced hepatocellular carcinoma in rats. *Molecular and Cellular Biochemistry*, 384(1-2), 2013, 147-153.
78. Krasteva I, Momekov G, Zdraveva P, Konstantinov S and Nikolov S. Antiproliferative effects of a flavonoid and saponins from *Astragalus hamosus* against human tumor cell lines. *Pharmacognosy Magazine*, 4, 2008, 269-272.
79. Dineva, I, Krasteva I, Berger M and Konstantinov S. In vitro antineoplastic activity of some cytoreductive drugs versus new compounds of plant origin. *International Journal of Current Chemistry*, 1(4), 2010, 281-290.
80. Momekov G, Krasteva I, Platikanov S, Nikolov S and Konstantinov S. Cytotoxic activity of volatiles from four Astragalus species. *Dokladi Na B Lgarskata Akademiâ Na Naukite*, 60, 2007, 1023-1026.

81. Kondeva-Burdina M, Krasteva I and Mitcheva M. Effects of rhamnocitrin 4-β-D-galactopyranoside, isolated from *Astragalus hamosus* on toxicity models in vitro. *Pharmacogn Mag*, 10(3), 2013, S487–S493.
82. Bensky D and Gamble A. Chinese Herbal Medicine: Materia Medica, Revised Edition. Seattle, WA, Eastland Press, 1993.
83. Williams MC. Toxicological investigations on *Astragalus hamosus* and *Astragalus sesameus* . Aust J Exp Agr, 20(103), 1980, 162-165.
84. http://www.iucnredlist.org/details/19378961/0
85. www.iucnredlist.org.
86. https://data.nbn.org.uk/Taxa/NHMSYS 0000456263
87. www.eFloras.org
88. http://www.iucnredlist.org/details/19378961/0
89. http://www.legumes-online.net/ildis /aweb/td025/td_ 05171.htm
90. http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl? 5903
91. Al-Douri N A, and Al-Essa LY. A survey of plants used in Iraqi traditional medicine. *Jordan Journal of Pharmaceutical Sciences*, 3(2), 2010, 100-108.
92. Bensky D and Gamble A. Chinese Herbal Medicine: Materia Medica, Revised Edition. Seattle, Eastland Press, 1993.
93. Hong YH. Oriental Materia Medica: A Concise Guide. Long Beach, CA: Oriental Healing Arts Institute, 1986.
94. http://www.efloras.org/florataxon.aspx? flora_id=2&taxon_id=242306836
95. http://www.mcp.edu/herbal/default.htm
96. Sinclair S. Chinese Herbs: A clinical review of Astragalus, Ligusticum, and Schizandrae. *Alternative Medicine Review*, 3(5), 1998, 338-344.
97. Dugoua J J, Wu P, Seely D, Eyawo O and Mills E. Astragalus-containing Chinese herbal combinations for advanced non-small-cell lung cancer: a meta-analysis of 65 clinical trials enrolling 4751 patients. *Cochrane Database of Systematic Reviews*, 1, 2010, 85-100.
98. Wu T, Munro A J, Guanjian L, and Liu G J. Chinese medical herbs for chemotherapy side effects in colorectal cancer patients. Cochrane Database of Systematic Reviews 2005, DOI: 10.1002/14651858.
99. McCulloch M, See C, Shu X J, Broffman M, Kramer A, Fan W Y, Gao J, Lieb W, Shieh K and Colford J M. Astragalus-based Chinese herbs and platinum-based chemotherapy for advanced non-small-cell lung cancer: meta-analysis of randomized trials. *Journal of Clinical Oncology*, 24(3), 2006, 419-430.
100. http://www.ncbi .nlm.nih.gov/pubmedhealth/ PMH0047755/
101. White P J, Bowen H C, Parmaguru P, Fritz M, Spracklen W P, Spiby R E, Meacham M C, Mead A, Harriman M, Trueman L J, Smith B M, Thomas B and Broadley M R. *Journal of Experimental Botany*, 55(404), 2004, 1927-1937.
102. Broadley M R. Interactions between selenium and sulphur nutrition in Arabidopsis thaliana. *Journal of Experimental Botany*, 55(404), 2004, 1927–1937.
103. Rayman MP. The importance of selenium to human health. *Lancet* , 356, 2000, 233–241.
104. Rayman M P. The argument for increasing selenium intake. *Proceedings of the Nutrition Society*, 61, 2002, 203–215.
105. Dhillon K S, Dhillon S K. Distribution and management of seleniferous soils. *Advances in Agronomy*, 79, 2003, 119–184.
106. Mikkelsen R L, Page A L, Bingham F T. Factors affecting selenium accumulation by agricultural crops. In: Selenium in agriculture and the environment. *Soil Science Society of America, Special Publication*, 23, 1989, 65–94.
107. Ebadi M. Pharmacodynamic basis of herbal medicine. Taylor & Francis Group , CRC Press, 2007, 121-122.
108. Brendler T, Gruenwald J and Jaenicke C. PDR for herbal medicines. 4th ed. Montvale (NJ), Thomson Healthcare Inc, 2007.
109. Spiteri M. Herbal monographs including herbal medicinal products and food supplements. University of Malta, Print Right Ltd, Qormi, 2011.