

## Review Article

## Chemical constituents and pharmacological importance of *Agropyron repens* – A review

Ali Esmail Al-Snafi\*

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

### \*Corresponding Author

**Ali Esmail Al-Snafi**

Department of Pharmacology,

College of Medicine,

Thi qar University, Iraq

E-mail: [aboahmad61@yahoo.com](mailto:aboahmad61@yahoo.com)

### Keywords:

Chemical constituents,

Pharmacology,

*Agropyron repens*

### Abstract

*Agropyron repens* is native from temperate Europe to Central Asia and is now found in Africa. It is used traditionally as soothing diuretic and for calming pain and spasm in the urinary tract. It is also used as demulcent and tonic. The plant contained carbohydrates, mucilaginous substances, pectin, triticin, cyanogenetic glycosides, phenol compounds, flavonoids, saponins, volatile oils, essential oil, vanillin glucoside, iron and other minerals, and large quantities of silica. It possessed hypoglycemic, hypolipidemic, anti-inflammatory and diuretic effects. It was also affected motility, cured urinary tract infection and induced many other effects. This review will highlight the chemical constituents and pharmacological effects of *Agropyron repens*.

## 1. Introduction

Different societies use plants according to their own beliefs, knowledge, and previous experiences. Recent reviews showed that the plants are rich source of a lot of secondary metabolites which possessed a wide range of pharmacological and therapeutic effect [1-76]. *Agropyron repens* is native from temperate Europe to Central Asia and is now found in Africa. It is used traditionally as soothing diuretic and for calming pain and spasm in the urinary tract. It is also used as demulcent and tonic. The plant contained carbohydrates, mucilaginous substances, pectin, triticin, cyanogenetic glycosides, phenol compounds, flavonoids, saponins, volatile oils, essential oil, vanillin glucoside, iron and other minerals, and large quantities of silica. It possessed hypoglycemic, hypolipidemic, anti-inflammatory and diuretic effects. It was also affected motility, cured urinary tract infection and induced many other effects. This review will highlight the chemical constituents and pharmacological effects of *Agropyron repens*.

## 2. Plant Profile

### 2.1 Synonyms:

*Agropyron firmum* J. Presl, *Agropyron repens* (L.) P. Beauv., *Elytrigia repens* (L.) Desv. ex Nevski, *Triticum firmum* (J. Presl) Link, *Triticum repens* L.[77].

### 2.2 Taxonomic classification:

**Kingdom:** Plantae; **Subkingdom:** Tracheobionta; **Superdivision:** Spermatophyta; **Division:** Magnoliophyta; **Class:** Liliopsida; **Subclass:** Commelinidae; **Order:** Cyperales; **Family:** Poaceae / Gramineae; **Genus:** *Elymus* L.; **Species:** *Elymus repens* (L.) [78].

### 2.3 Common names:

**Arabic:** najeel, echresh, najim, **Deutsch:** queckenwurzelstock; **English:** couch grass, couch, dog grass, quack grass, quick grass, scotch, twitch grass; **French:** chiendent, chiendent rampant, petit chiendent; **German:** ackerquecke, quecke; **Português:** Grama francesa, rizoma; **Spanish:** grama canina; **Italian:** gramigna rizoma [77,79].

### 2.4 Distribution

It is native from temperate Europe to Central Asia and is now found in **Africa:** Algeria, Morocco and Tunisia; **Asia:** Afghanistan, Cyprus, Iran; Iraq, Lebanon, Syria, Turkey, Armenia, Azerbaijan, Georgia, Russian Federation, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Mongolia, China, Korea, India and Pakistan; **Europe:** Denmark, Finland, Iceland, Ireland, Norway,

Sweden, United Kingdom, Austria, Belgium, Czech Republic, Germany, Hungary, Netherlands, Poland, Switzerland, Belarus, Estonia, Latvia, Lithuania, Moldova, Russian Federation- European part, Ukraine, Albania, Bulgaria, Croatia, Greece, Italy, Romania, Serbia, Slovenia, France and Spain. It introduced in wide areas in the world as a contaminant in hay or straw, quackgrass has now been reported from every state in the United States and throughout Canada. This invasive grass is found in both natural grassland communities and agricultural fields. It invades gardens, lawns, roadsides, ditches, and other moist areas [77,80].

### 2.5 Traditional uses: [1-4]

*Agropyron repens* is used as soothing diuretic and for calming pain and spasm in the urinary tract. It is also used as demulcent, and tonic. It is widely used in children's conditions associated with urinary system (e.g. enuresis and urinary incontinence), for the control of symptoms of urinary disease, prostatic disease, rheumatism, urinary calculi and urinary infections (cystitis, urethritis, prostatitis) [80-87].

### 2.6 Description

Quackgrass is a strongly rhizomatous perennial plant. The rhizomes are long, highly branched, yellowish-white, sharp-pointed, and somewhat fleshy. Stems are erect and usually 1-3 feet tall. Leaf blades are ¼-½ of an inch wide, flat, and pointed and have small auricles at the junction of blade and sheath. Leaf blades often have a diagnostic slight constriction near the tip and are sparsely hairy above and hairless below. Spikelets are arranged in two long rows and borne flatwise to the stem. The florets are awnless to short-awned. Seeds are elliptical and pale yellow to brown [88-89].

### 2.7 Part used: Rhizome, root and seeds

### 2.8 Chemical constituents:

The plant contained carbohydrates (fructose, glucose, inositol, mannitol), mucilaginous substances (10%), pectin, triticin, cyanogenetic glycosides, flavonoids, saponins, volatile oils 0.05%, essential oil (0.01-0.02%), 25% monoterpenes (carvacrol, carvon, trans-anethole, thymol and menthol, among others) and 0.85% sesquiterpenes, 25% monoterpenes (carvacrol, carvon, trans-anethole, thymol and menthol, among others) and 0.85% sesquiterpenes. Other constituents included vanillin glucoside, iron and other minerals, and large quantities of silica [84-86, 90-92].

Phenol compounds found in the plant were included: P-hydroxybenzoic, vanilic and p-coumaric acids, Chlorogenic acid, p-hydroxycinnamic acids, P-hydroxycinnamic acid esters: (E)- and (Z)-

p-coumaric acid hexadecyl ester and (E)- and (Z)-p-coumaric acid-16-hydroxyhexadecylester and bis-(E)- and bis-(Z)-diesters of analogous structure [93-96].

Quack Grass seed contained oil 12%, triticin, mucilage 10%, saponins, sugar alcohols (mannitol, inositol, 2% to 3%), essential oil with polyacetylenes or carvone (0.01% to 0.05%), small amounts of vanilloside (vanillin monoglucoside), vanillin, and phenolcarboxylic acids, silicic acid and silicates [97].

As a nutritive value, *Agropyron repens* contained: dry matter 95%, organic matter 88.7%, crude protein 8.9%, crude fiber 34.3%, ether extract 1.44%, ash 11.2%, non fibrous carbohydrates 8.96%, neutral detergent fiber 69%, acid detergent fiber 38.3%, hemicelluloses 31.1%, acid detergent lignin 5.7%, acid insoluble ash 1.15%, liquification index 8.1, Gross energy (Kcal / Kg) 4285.1 [86].

Allelopathic constituents of ethylacetate extracts from shoots and root exudates of 10-day old *Agropyron repens* seedlings were investigated. The allelochemicals identified in shoot extracts included the cyclic hydroxamic acids 2,4-dihydroxy-7-methoxy-2H-1,4-benzoxazin-3-one (DIMBOA) and 2,4-dihydroxy-2H-1,4-benzoxazin-3-one (DIBOA), as well as the corresponding lactam derivative 2-hydroxy-1,4-benzoxazin-3-one (HBOA). The concentration of major component DIBOA was 0.5 mg/g fresh weight, the concentration of DIMBOA was 0.02 mg/g fresh weight. Furthermore maleic, t-aconitic and citric acid were found. In order to estimate the allelopathic potential of living plants an investigation of root exudates was performed. The cyclic hydroxamic acids were identified as important constituents. Their concentrations were 0.4  $\mu\text{mol l}^{-1}$  DIMBOA and 0.2  $\mu\text{mol l}^{-1}$  DIBOA. Additionally 2,4-dihydroxy-7,8-dimethoxy-2H-1,4-benzoxazin-3-one (DIM2BOA) was detected. Vanillic, ferulic and  $\beta$ -hydroxybutyric acid are also phytotoxins released by intact, living quackgrass seedlings [98].

### 3. Pharmacological effects

#### 3.1 Hypoglycemic effects

The hypoglycaemic effect of an aqueous extract of *Agropyron repens* (*Triticum repens*) rhizomes was investigated in normal and streptozotocin (STZ) diabetic rats. After a single oral administration of the aqueous extract (20mg/kg) a significant decrease on blood glucose levels in STZ diabetic rats ( $p < 0.001$ ) was observed; the blood glucose levels were normalized after 2 weeks of daily oral administration of aqueous extract (20mg/kg) ( $p < 0.001$ ). Significant reduction on blood glucose levels were noticed in normal rats after both acute ( $p < 0.001$ ) and chronic treatment ( $p < 0.001$ ). In addition, no changes were observed in basal plasma insulin concentrations after treatment in either normal or STZ diabetic rats indicating that the underlying mechanism of this pharmacological activity seems to be independent of insulin secretion [99].

#### 3.2 Hypolipidemic effects

The effect of single and repeated oral administration of the lyophilized aqueous extract of rhizomes of *Agropyron repens* (20 mg/kg) on lipid metabolism was studied in normal and streptozotocin-induced diabetic rats. In normal rats, the aqueous extract induced a significant decrease in the plasma triglycerides concentrations 4 days and 1 week after repeated oral administration. This reduction was abolished 2 weeks after once daily repeated oral administration. A significant decrease of plasma cholesterol levels was observed only 1 week after repeated oral administration. In diabetic rats, the treatment caused a significant decrease in plasma cholesterol after a single and repeated oral administration. A strong decrease in cholesterol levels was observed 6 hours after a single oral administration of the extract. Four days after the repeated oral administration of the extract, the plasma cholesterol level was significantly decreased and remained still diminished after 2 weeks. Repeated oral administration of the aqueous extract of *Agropyron repens* rhizome caused a significant decrease in body weight 2 weeks after oral treatment. In severely hyperglycaemic rats, *Agropyron*

*repens* extract treatment induced reduction of lipid levels and body weight [100].

#### 3.3 Effects on Motility

Experiments were performed on rota-rod with male mice (20-30 g body weight). Each group of mice (N=30) received either orally or i.p. 10% infusion of *Rhizoma graminis* (either 40 or 80 mg/20 g mouse). Motility tests were performed 2 and 8 hours after administration of the tested solutions. The tested plant products induced comparable significant dose-dependent inhibition of motility [101].

#### 3.4 Anti-inflammatory

Oral administration of 80% ethanol extract of rhizomes of *Agropyron repens* (100 mg/kg) induced moderate inhibition of carrageenan foot oedema of the rat hind-paw (14%) compared to indometacin (45% of inhibition) at 5 mg/kg [102].

The cream containing dry couch grass extract was tested in allergic contact dermatitis induced topically in rats after depilation with two applications of 0.1 ml of 5% alcoholic solution 2,4-dinitrochlorobenzene (DNCB). After DNCB use, the skin was hyperaemic, oedematous with serious purulent changes and itching. Couch grass extract cream was applied 3 days after the beginning of sensitization. The anti-inflammatory activity of the cream was monitored 4, 6 and 10 days after the beginning of the experiment. Plasma lipid peroxidation parameters malondialdehyde (MDA), diene conjugates (DC) and catalase activity were evaluated. After 2 days of treatment (4<sup>th</sup> day of the experiment) with couch grass cream, a decrease of erythema, oedema and infiltration was recorded. On the 6<sup>th</sup> day of the experiment, the skin of rats treated with the cream containing couch grass returned to baseline values with a reduction of oedema and erythema. The activity of catalase was increased by 30% at the 4<sup>th</sup> day and by 15% at the 6<sup>th</sup> day of the experiment, compared to the control. At the end of the experiment on the 10<sup>th</sup> day, The activity of MDA was within the control limit with an increase in the activity of catalase. The couch grass cream application quickened the recovery by 4-5 days as compared with untreated control animals. The anti-inflammatory effects of the couch grass cream were comparable to the standard glucocorticoid cream activity [93].

#### 3.5 Diuresis and treatment of urinary tract infections:

The sugar mannitol present in large quantities in this herb, and is known as a standard 'osmotic diuretic', that is, it is absorbed whole from the gut and excreted largely by the kidney tubules. Its presence in the tubules means that extra water has to be retained in order to maintain osmotic pressure. The saponins and vanillin, also have diuretic properties. Because of Couch grass diuretic and antimicrobial effects, it was used to flush out the urinary tract during infections [103].

A post-marketing surveillance was designed to investigate the efficacy and tolerability of a fluid extract of *Agropyron repens* [*Elymus repens*] (Acorus drops) in patients with urinary tract infections or irritable bladder. Data for 313 patients with urinary tract infections or irritable bladder were analysed. The patients were treated on average for twelve days with 50-60 drops 3 times a day. The primary efficacy criterion was the change of urological symptoms during the course of therapy. Between 69% and 91% of the urological symptoms initially documented were relieved in the course of therapy. Depending on the underlying urological diagnosis, between 32% and 53% of the patients were completely free of symptoms following treatment. Acorus drops were tolerated very well. No adverse drug reactions occurred [104].

In an open clinical trial in 99 patients with micturition disorders (12 female and 87 male), a 20% ethanol fluid extract of *Agropyron repens* was administered for 28-31 days (60 drops 3 times daily). The complaints of urge incontinence, dysuria, nycturia and tenesmus due to adenoma of prostate, prostatitis and cystitis were significantly reduced in 44.4-100% of patients. Laboratory markers of inflammation (protein, epithelia, leucocytes and erythrocytes in urine) were also normalized. 96% of patients

mentioned that the treatment is good or very good. Adverse effects were not recorded [100].

### 3.6 Other pharmacological effects:

Quackgrass, which is rich in silica, potassium and other minerals, has always been used as a natural medicine. During the food shortages of the First World War, bread made from quackgrass was popular in southern Germany. The seeds as well as the rhizomes were used to produce a nutritious flour to replace wheat and other grains [105].

A product named Tritipalm represents a combination of 60 grains of the fresh root of triticum and 30 grains of the fresh fruit of saw palmetto (*Serenoa serrulata*), in each fluid drachm is designed as a general nutrient tonic and sedative to irritated and inflamed states of the mucous membranes of nose, throat, and bronchiae, especially arresting purulent discharges; it also acts upon the glandular appendages of the reproductive tract. It is specially recommended in nephritis, simple and gonorrhoeal urethritis, cystitis, vesical irritability, strangury, dysuria, and atrophy of the mammae, testes, ovaries, uterus, and especially of the prostate gland. The dose is 1 fluid drachm, followed by a draught of water, 4 times a day [103].

However, Grases *et al.*, found that *Agropyron repens* L. exerted no effect on urolithiasis risk factors when given to the rats in combination with different diets (standard, high glucidic and high protein) [106].

It was one of the medicinal plants used to treat endoparasites and stomach problems in dogs, cats and pigs in British Columbia, and Canada [107].

It appeared that *Agropyron repens* was phytotoxic. Favonoids were the compounds which produced the phytotoxic effects [108-109].

### 3.7 Contraindication and adverse effects:

Couch grass is listed by the Council of Europe as a natural source of food flavoring (category N2). In the United States, it is listed as GRAS (Generally Recognized as Safe). The safety and efficacy of couch grass has not been systematically studied for any indication in available reports. However, traditional use suggests that couch grass is generally well tolerated. Couch grass is accepted in the Indian and Colonial Addendum of the British Pharmacopoeia for use in the Australian, Eastern and North American Colonies, where it is much employed. Excessive and prolonged use of couch grass should be avoided due to its reputed diuretic action, as this may result in hypokalemia (abnormally low potassium levels in the blood). Caution is advised in patients who have edema (swelling) caused by heart or kidney disease. Based on tradition, couch grass should be taken with plenty of fluids to flush out the urinary tract [109-110].

### 3.8 Dosage:

Dried rhizome 4-8 g or in decoction three times daily. Liquid extract 4-8 ml (1:1 in 25% alcohol) three times daily. Tincture 5-15 ml (1:5 in 40% alcohol) three times daily [84,92,109,111].

The use in children and adolescents under 18 years of age is not recommended. Duration of use: The herbal substance is traditionally used over a period of 2 up to 4 weeks. Method of administration: Oral use [79].

## 4. Conclusion

This review discuss the chemical constituent, pharmacological and therapeutic importance of *Agropyron repens* as a promising drug as a result of wide range of pharmacological effects.

## References

- [1] 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.
- [2] Al-Snafi AE. Pharmacological effects of *Allium* species grown in Iraq. An overview. *International Journal of Pharmaceutical and health care Research* 2013; 1(4):132-147.
- [3] Al-Snafi AE. Chemical constituents and pharmacological activities of Milfoil (*Achillea santolina*) - A Review. *Int J Pharm Tech Res* 2013, 5(3): 1373-1377.
- [4] Al-Snafi AE. The Pharmacological importance of *Althaea officinalis* and *Althaea rosea*: A Review. *Int J Pharm Tech Res* 2013; 5(3):1387-1385.
- [5] 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.
- [6] Al-Snafi AE. The pharmacology of *Bacopa monniera*. A review. *International Journal of Pharma Sciences and Research* 2013; 4(12): 154-159.
- [7] Al-Snafi AE. The Pharmacological importance of *Bauhinia variegata*. A Review. *Journal of Pharma Sciences and Research* 2013; 4(12): 160-164.
- [8] Al-Snafi AE. The Pharmacological Importance of *Benincasa hispida*. A review. *Int Journal of Pharma Sciences and Research* 2013; 4(12): 165-170.
- [9] Al-Snafi AE. The Chemical constituents and pharmacological effects of *Bryophyllum calycinum*. A review. *Journal of Pharma Sciences and Research* 2013; 4(12): 171-176.
- [10] Al-Snafi AE. The pharmacological activities of *Alpinia galangal* - A review. *International Journal for Pharmaceutical Research Scholars* 2014; 3(1-1): 607-614.
- [11] 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.
- [12] Al-Snafi AE. The Pharmacological importance and chemical constituents of *Arctium Lappa*. A review. *International Journal for Pharmaceutical Research Scholars* 2014; 3(1-1): 663-670.
- [13] Al-Snafi AE. The Pharmacology of *Apium graveolens*. - A review. *International Journal for Pharmaceutical Research Scholars* 2014; 3(1-1): 671-677.
- [14] 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.
- [15] Al-Snafi AE. The pharmacological importance of *Anethum graveolens* - A review. *International Journal of Pharmacy and Pharmaceutical Sciences* 2014; 6(4): 11-13.
- [16] Al-Snafi AE, Wajdy JM and Tayseer Ali Talab. Galactagogue action of *Nigella sativa* seeds. *IOSR Journal of Pharmacy* 2014; 4(6): 58-61.
- [17] 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.
- [18] Al-Snafi AE. The pharmacological and therapeutic importance of *Agrimonia eupatoria*- A review. *Asian Journal of Pharmaceutical Science and Technology* 2015; 5(2): 112-117.
- [19] Al-Snafi AE. The chemical constituents and pharmacological effects of *Ammannia baccifera* - A review. *International Journal of Pharmacy* 2015; 5(1): 28-32.
- [20] Al-Snafi AE. The chemical contents and pharmacological effects of *Anagallis arvensis* - A review. *International Journal of Pharmacy* 2015; 5(1): 37-41.
- [21] Al-Snafi AE, RM Hanaon, NY Yaseen, WS Abdul alhussain. Study the anticancer activity of plant phenolic compounds. *Iraqi Journal of Cancer & Medical Genetics* 2011; 4(2): 66-71.
- [22] Al-Snafi AE. The pharmacological importance of *Artemisia campestris*- A review. *Asian Journal of Pharmaceutical Research* 2015; 5(2): 88-92.
- [23] Al-Snafi AE. Chemical constituents and pharmacological effects of *Asclepias curassavica* - A review. *Asian Journal of Pharmaceutical Research* 2015; 5(2): 83-87.
- [24] Al-Snafi AE. The pharmacological importance of *Asparagus officinalis* - A review. *Journal of Pharmaceutical Biology* 2015; 5(2): 93-98.



- [25] Al-Snafi AE. The medical importance of *Betula alba* - An overview. *Journal of Pharmaceutical Biology* 2015; 5(2): 99-103.
- [26] Al-Snafi AE. Bioactive components and pharmacological effects of *Canna indica*- An Overview. *International Journal of Pharmacology and toxicology* 2015; 5(2):71-75.
- [27] Al-Snafi AE. The chemical constituents and pharmacological effects of *Capsella bursa-pastoris* - A review. *International Journal of Pharmacology and toxicology* 2015; 5(2):76-81.
- [28] Al-Snafi AE. The pharmacological importance of *Ailanthus altissima*- A review. *International Journal of Pharmacy Review and Research* 2015; 5(2):121-129.
- [29] Al-Snafi AE. *Alhagi maurorum* as a potential medicinal herb: An Overview. *International Journal of Pharmacy Review and Research* 2015; 5(2):130-136.
- [30] Al-Snafi AE. The pharmacological importance of *Aloe vera*- A review. *International Journal of Phytopharmacy Research* 2015; 6(1): 28-33.
- [31] Al-Snafi AE. The constituents and biological effects of *Arundo donax* - A review. *International Journal of Phytopharmacy Research* 2015; 6(1): 34-40.
- [32] Al-Snafi AE. The nutritional and therapeutic importance of *Avena sativa* - An Overview. *International Journal of Phytotherapy* 2015; 5(1): 48-56.
- [33] Al-Snafi AE. The Pharmacological importance of *Bellis perennis* - A review. *International Journal of Phytotherapy* 2015; 5(2): 63-69.
- [34] 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.
- [35] Al-Snafi AE. The chemical constituents and pharmacological effects of *Carum carvi* - A review. *Indian Journal of Pharmaceutical Science and Research* 2015; 5(2): 72-82.
- [36] Al-Snafi AE. The pharmacological importance of *Casuarina equisetifolia* - An Overview. *International Journal of Pharmacological Screening Methods* 2015; 5(1): 4-9.
- [37] 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.
- [38] Al-Snafi AE, The effect of date palm pollens and zinc sulphate in the treatment of human male infertility. *Tikrit Journal of Pharmaceutical Sciences* 2006; 2(1): 31-34.
- [39] Al-Snafi AE. Pharmacology and medicinal properties of *Caesalpinia crista* - An overview. *International Journal of Pharmacy* 2015; 5(2): 71-83.
- [40] Al-Snafi AE. The chemical constituents and pharmacological effects of *Calendula officinalis* - A review. *Indian Journal of Pharmaceutical Science & Research* 2015; 5(3): 172-185.
- [41] Al-Snafi AE. The constituents and pharmacological properties of *Calotropis procera* - An Overview. *International Journal of Pharmacy Review & Research* 2015; 5(3): 259-275.
- [42] 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.
- [43] Al-Snafi AE. The chemical constituents and pharmacological importance of *Carthamus tinctorius* - An overview. *Journal of Pharmaceutical Biology* 2015; 5(3): 143-166.
- [44] Al-Snafi AE. The therapeutic importance of *Cassia occidentalis* - An overview. *Indian Journal of Pharmaceutical Science & Research* 2015; 5 (3): 158-171.
- [45] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of their detoxification capacity and protective effects (part 1). *Asian Journal of Pharmaceutical Science & Technology* 2015; 5(4): 257-270.
- [46] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of plants with hypolipidemic, hemostatic, fibrinolytic and anticoagulant effects (part 1). *Asian Journal of Pharmaceutical Science & Technology* 2015; 5(4): 271-284.
- [47] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of their effect on reproductive systems (part 1). *Ind J of Pharm Sci & Res* 2015; 5(4): 240-248.
- [48] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of their gastro-intestinal effects (part 1). *Ind J of Pharm Sci & Res* 2015; 5(4): 220-232.
- [49] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of their antiparasitic, antiprotozoal, molluscicidal and insecticidal activity (part 1). *J of Pharmaceutical Biology* 2015; 5(3): 203-217.
- [50] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of plants with antidiabetic effects (part 1). *J of Pharmaceutical Biology* 2015; 5(3): 218-229.
- [51] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of plants with antifungal activity (part 1). *Int J of Pharm Rev & Res* 2015; 5(3):321-327.
- [52] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of their dermatological effects (part 1). *Int J of Pharm Rev & Res* 2015; 5(4):328-337.
- [53] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of plants with anticancer activity (part 1). *Int J of Pharmacy* 2015; 5(3): 104-124.
- [54] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of plants with anti-inflammatory, antipyretic and analgesic activity (part 1). *Int J of Pharmacy* 2015; 5(3): 125-147.
- [55] Al-Snafi AE. Cardiovascular effects of *Carthamus tinctorius*: A mini-review. *Asian Journal of Pharmaceutical Research* 2015; 5(3): 199-209.
- [56] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of their immunological effects (part 1). *Asian Journal of Pharmaceutical Research* 2015; 5(3): 208-216.
- [57] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of their antibacterial activity (part 1). *International Journal of Pharmacology and Toxicology* 2015; 6(3): 137-158.
- [58] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of plants with antioxidant activity (part 1). *International Journal of Pharmacology and Toxicology* 2015; 6(3): 159-182.
- [59] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of their respiratory effects (part 1). *International Journal of Pharmacological Screening Methods* 2015; 5(2):64-71.
- [60] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of their antiviral activity (part 1). *International Journal of Pharmacological Screening Methods* 2015; 5(2): 72-79.
- [61] Al-Snafi AE. Galactagogue action of the crude phenolic extracts of grape seeds (*Vitis vinifera*). *International Journal of Biological & Pharmaceutical Research* 2015; 6(8): 577-580.
- [62] Al-Snafi AE. Mammary gland stimulating effects of the crude phenolic extracts of green tea (*Camellia sinensis*). *International Journal of Biological & Pharmaceutical Research* 2015; 6(7): 573-576.
- [63] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of plants with cardiovascular effects (part 1). *Int J of Pharmacology & Toxicology* 2015; 5(3): 163-176.
- [64] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of medicinal plants with central nervous effects (part 1). *Int J of Pharmacology & Toxicology* 2015; 5(3): 177-192.
- [65] Al-Snafi AE. The pharmacological Importance of *Antirrhinum majus* - A review. *Asian J of Pharm Sci & Tech* 2015; 5(4): 313-320.
- [66] 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.
- [67] Al-Snafi AE. The Pharmacological Importance of *Ballota nigra* - A review. *Ind J of Pharm Sci & Res* 2015; 5(4): 249-256.

- [68] Al-Snafi AE. Chemical constituents and pharmacological importance of *Bidens tripartita* - A review. *Ind J of Pharm Sci & Res* 2015; 5(4): 257-263.
- [69] Al-Snafi AE. The pharmacological importance of *Brassica nigra* and *Brassica rapa* grown in Iraq. *J of Pharm Biology* 2015; 5(4): 240-253.
- [70] Al-Snafi AE. The chemical constituents and pharmacological importance of *Celosia cristata* – A review. *J of Pharm Biology* 2015; 5(4): 254-261.
- [71] Al-Snafi AE. The pharmacological importance of *Centaurea cyanus*- A review. *Int J of Pharm Rev & Res* 2015; 5(4): 379-384.
- [72] Al-Snafi AE. The chemical constituents and pharmacological importance of *Chrozophora tinctoria*. *Int J of Pharm Rev & Res* 2015; 5(4): 391-396.
- [73] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of plants affected smooth muscles functions (part 1). *Int J of Pharmacy* 2015; 5(2): 90-97.
- [74] Al-Snafi AE. Medicinal plants with anti-urolithiatic effects (part1). *Int J of Pharmacy* 2015; 5(2): 98-103.
- [75] Al-Snafi AE, Allahwerdi, IY. and Jawad IA. Using of topical 5% urtica dioica ointment in treatment of psoriasis. *European Journal of Biomedical and Pharmaceutical Sciences* 2015; 2(4):103-111.
- [76] 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* 2005; 1(1): 30-35.
- [77] United States Department of Agriculture, Agricultural Research Service, Beltsville Area Germplasm Resources Information, <http://plants.usda.gov/core/profile?symbol=ELRE4> [07 October 2014].
- [78] United States Department of Agriculture, Natural resources conservation services, <http://plants.usda.gov/java/profile?symbol=ELRE4>
- [79] European medicine agency, Committee on Herbal Medicinal Products (HMPC), Community herbal monograph on *Agropyron repens* (L.) P. Beauv., rhizome. [http://www.ema.europa.eu/docs/en\\_GB/document\\_library/Herbal\\_-\\_herbal\\_monograph/2012/01/WC500120708.pdf](http://www.ema.europa.eu/docs/en_GB/document_library/Herbal_-_herbal_monograph/2012/01/WC500120708.pdf) [22 November 2011].
- [80] Blake S. Medicinal plants action. LifeLong Press 2004.
- [81] Front P. *Plantas Medicinalis*. El Dioscorides Renovado. Labor Ed., Bachelona, Spin 1983.
- [82] Palau PC. *Les Plantes Medicinalis*. B aleariques. Moll Ed., Palmade Mallorca, Spin 1983.
- [83] Volak J, Stodola J and Severa F. *Plantas Medicinalis*. Artia Ed., Prague, Czechoslovakia 1983.
- [84] Mills S. The complete guide to modern herbalism. Thorsons, Great Britain 1994.
- [85] Hoffmann D. The new holistic herbal. Element, Dorset 1990.
- [86] Maheri-Sis N, Mirzaei-Aghsaghali A, Safaei AR, Mirza-Aghazadeh A and Bibalani GH. Quack grass (*Agropyron repens* L.) as ruminant fed. *Research Journal of Environmental Sciences* 2008; 2(3):228-233.
- [87] British Herbal Pharmacopoeia. BHMA, Bournemouth 1983.
- [88] Quackgrass, *Elymus repens* (L.) Gould [http://www.nps.gov/akso/natres/epmt/Species\\_bios/Elymus%20repens.pdf](http://www.nps.gov/akso/natres/epmt/Species_bios/Elymus%20repens.pdf)
- [89] Whitson TD, Burrill LC, Dewey SA, Cudney DW, Nelson BE, Lee RD and Parker R. Weeds of the West. The Western Society of Weed Science in cooperation with the Western United States Land Grant Universities, Cooperative Extension Services. University of Wyoming. Laramie, Wyoming 2000:630.
- [90] Boesel R and Schilcher H. Composition of the essential oil of *Agropyrum repens* rhizome. *Planta Med* 1989; 55: 399- 400.
- [91] Bradley PR (ed.). British herbal compendium. Vol 1. Bournemouth, British Herbal Medicine Association 1992.
- [92] British Pharmaceutical Codex 1973. London, Pharmaceutical press 1973.
- [93] Petrova AP, Krasnov EA, Saprykina EV, Subbotina YA, Ermilova EV. Chemical composition of couch grass and studies of its antioxidant activity in allergic contact dermatitis. *Pharm Chemistry J* 2009; 43:30-32.
- [94] Koetter U, Kaloga M and Schilcher H. Isolierung und Struktur-aufklärung von p-Hydroxyzimtsäurealkylester-Verbindungen aus dem Rhizom von *Agropyron repens*; *Mitteilung. Planta Med* 1993; 59:279-280.
- [95] Koetter U, Kaloga M and Schilcher H. Isolierung und Struktur-aufklärung von p-Hydroxyzimtsäurealkylester-Verbindungen aus dem Rhizom von *Agropyron repens*; *Mitteilung. Planta Med* 1994; 60:488-489.
- [96] Whitehead DC, Dibb H and Hartley RD. Phenolic compounds in soil as influenced by the growth of different plant species. *J Appl Ecology* 1982; 19:579-588.
- [97] Deane J. Quackgrass, <http://www.eattheweeds.com/quack-grass/> [26 Aug 2014].
- [98] Friebe A, Schulz M, Kück P and Schnabl H. Phytotoxins from shoot extracts and root exudates of *Agropyron repens* seedlings. *Phytochemistry* 1995; 38(5): 1157-1159.
- [99] Eddouks M, Maghrani M, and Michel JB. Hypoglycaemic effect of *Triticum repens* P. Beauv. in normal and diabetic rats. *J Ethnopharmacol.* 2005; 102(2):228-232.
- [100] An agency of the European Union. Assessment report on *Agropyron repens* (L.) P. Beauv., rhizome [22 Nov 2011], [http://www.ema.europa.eu/docs/en\\_GB/document\\_library/Herbal\\_-\\_HMPC\\_assessment\\_report/2012/01/WC500120706.pdf](http://www.ema.europa.eu/docs/en_GB/document_library/Herbal_-_HMPC_assessment_report/2012/01/WC500120706.pdf)
- [101] Kiesewetter R, Müller M. Zur Frage der "sedativen" Wirkung von *Radix Valerianae*. *Pharmazie* 1958; 13:777-781.
- [102] Mascolo N. Biological screening of Italian medicinal plants for anti-inflammatory activity. *Phytother Res* 1987; 1: 28-29.
- [103] MDidea, [www.mdidea.com](http://www.mdidea.com) [April 17th 2014].
- [104] Hautmann C. and Scheithe K. Fluid extract of *Agropyron repens* for the treatment of urinary tract infections or irritable bladder. Results of multicentric post-marketing surveillance. *Zeitschrift für Phytotherapie* 2000; 21(5):252-255.
- [105] Hagin RD and Bobnick SJ. Isolation and identification of a slug-specific molluscicide from quackgrass (*Agropyron repens*). *Journal of Agricultural and Food Chemistry* 1991; 39:192-196.
- [106] Grases F, Ramis M, Costa-Bauza A and March JC. Effect of *Herniaria hirsute* and *Agropyron repens* on calcium oxalate urolithiasis risk in rat. *Journal Ethnopharmacology* 1995; 45: 211-214.
- [107] Lans C, Turner N, Khan T, and Brauer G. Ethnoveterinary medicines used to treat endoparasites and stomach problems in pigs and pets in British Columbia, Canada. *Vet Parasitol* 2007; 148(3-4):325-340.
- [108] Weston LA *et al.* Isolation, characterization and activity of phytotoxic compounds from quackgrass [*Agropyron repens* (L.) Beauv.]. *J Chem Ecol* 1987; 13: 403-421.
- [109] Newall CA, Anderson LA and Phillipson JD. Herbal medicines, a guide for health – care professionals. The Pharmaceutical Press, London 1996: 91.
- [110] Couch grass (*Agropyron repens*, *Elymus repens*), <http://www.livingnaturally.com/ns/DisplayMonograph.asp?StoreID=E32FA6C399AB4C99897032581851D45D&DocID=bottomline-couchgrass>
- [111] Willard T. The Wild Rose Scientific Herbal. Wild Rose College of Natural Healing Ltd, Alberta, Canada 1991.