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The chemical constituents and therapeutic importance of *Cressa cretica*- A review

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Abstract: *Cressa cretica* contained many biologically active constituents including coumarins, sterols, alkaloids, tannins, glycosides (cardiac glycoside, anthraquinone glycoside), protein, carbohydrate, flavonoids, unidentified sugars and high salt content. The pharmacological studies of *Cressa cretica* revealed that the plant possessed bronchodilatory, antitussive, reproductive, nootropic, antidiabetic antibacterial, antifungal, antioxidant, anti-inflammatory, antipyretic, and analgesic effects. This review will highlight the chemical constituents and medical importance of *Cressa cretica*.
Keywords: *constituents, pharmacology, Cressa cretica***.**

I. INTRODUCTION

A large and increasing number of patients in the world use medicinal plants and herbs for health purpose. Therefore, scientific scrutiny of their therapeutic potential, biological properties, and safety will be useful in making wise decisions about their use[(1)]. Recent reviews showed that plants produce many secondary metabolites which are bio-synthetically derived from primary metabolites and constitute an important source of many drugs [(2-40)]. *Cressa cretica* contained many biologically active constituents including coumarins, sterols, alkaloids, tannins, glycosides (cardiac glycoside, anthraquinone glycoside), protein, carbohydrate, flavonoids, unidentified sugars and high salt content. The pharmacological studies of *Cressa cretica* revealed that the plant possessed bronchodilatory, antitussive, reproductive, nootropic, antidiabetic antibacterial, antifungal, antioxidant, anti-inflammatory, antipyretic, and analgesic effects. This review will highlight the chemical constituents and medical importance of *Cressa cretica*.

II. PLANT PROFILE

Synonyms: *Cressa loscosii* Tremols and *Cressa villosa* Hoffmanns & Link[(41)].
Taxonomic classification:
Kingdom: Plantae ; **Phylum**: Angiosperms; **Class**: Magnoliatae; **Subclass**: Asteridae; **Order**: Polemoniales; **Family**: Convolvulaceae; **Genus**: *Cressa*; **Species**: *Cressa cretica*[(1)].
Common names:

Arabic: Molleih, Nadewa**; Bengali**: Rudravanti; **English:** Alkali weed, Rosin weed, Cressa; **French**: Cresse de Crète, Cresse à feuilles d'herniaire; **Hindi**: Rudravanti; **Poland:** Erva molhada[(42-45)].

Distribution

This species occurs from the Mediterranean east through western, central and south east Asia, south to northern and central Africa, south America and Australia. However, it was distributed in Afghanistan; Albania; Algeria; Angola (Angola); Australia (new south Wales, northern Territory, Queensland, south Australia, Victoria, western Australia); Bahrain; Bulgaria; Cyprus; Egypt; Ethiopia; France; Greece; Guinea-Bissau; India; Indonesia; Iran, Iraq, Palestine; Italy; Jordan; Kenya; Lebanon; Libya; Madagascar; Malta; Mauritania; Morocco; Mozambique; Oman; Pakistan; Portugal; Senegal; Somalia; Spain; Sri Lanka; Sudan; Syria; Tunisia and Yemen[(41, 45)].

Description:

Cressa cretica is an erect, small, dwarf shrub upto 38cm height. Roots are horizontal, geminate, with lateral branches leading upward to produce above-ground parts. It is a perennial sub shrub or herb, usually much-branched. Stems are at first erect and then become decumbent, apparently short-lived, gray appressed pilose to sericeous. Leaves on main branches are often larger than those on branchlets, the blade 1-12 mm long, lanceolate, ovate or elliptic- to scalelike, sessile, Peduncle lengths, stamen lengths, filament pubescence and ranges distinguish. Flowers are solitary, white or pink, axillary, 5-8 mm long, sessile or on short peduncles, bracteates, in spicate to head-like clusters at tips of branchlets, bracteoles unequal in length. Sepals ovate to obovate imbricate. Corolla salver form, the limb 5-lobed, the lobes mostly ovate, imbricate, spreading to reflexed. Stamens exserted; filaments filiform; styles exserted. Ovary 2- locular, 4-ovulate; styles 2, distinct to

the base; stigmas capitate. Fruit is capsular, ovoid, unilocular, 2-4-valved, and usually one-seeded. Seeds are 3-4 mm long, glabrous and smooth, and shining to reticulate, dark brown[45-46].

Traditional uses:

The plant was used traditionally as anthelmintic, stomachic, tonic, aphrodisiac, for constipation, leprosy, asthma and urinary discharges. In Senegal a maceration of the whole plant (together with the barks of *Vitex cuneata* Thonn and *Faidherbia albida* (Delile) A.Chev) was drunk against bronchitis. In Sudan a maceration of the aerial parts was drunk as a tonic. A decoction of the stems (together with leaves of *Vitex doniana* Sweet) was applied topically against skin eruptions as in smallpox. In Sudan crushed dry leaves with sugar were taken as an emetic [41, 46-47].

Physicochemical parameters:

Total ash 5.23 (% w/w), acid soluble ash 1.24 (% w/w), water soluble ash 0.87 (% w/w), sulphated ash 3.12 (% w/w), extractive values: hexane 3.390 (%), ethyl acetate 7.6-8.621(%), methanol 4.440- 14.4 (%), petroleum ether 1.5%, chloroform 4.8%, n-butanol 3.2% and water 27.2%[48-49].

Chemical constituents:

The plant contained coumarins, sterols, alkaloids, tannins, glycosides (cardiac glycoside, anthraquinone glycoside), protein, carbohydrate, flavonoids, unidentified sugars and high salt content[49-53].

Creticane, cressatetracosanoate, cressanonacontanoic acid, cressatetratriacontanoic acid, cressatriacontanone, cressanaphthacenone, cressatriterpenic acid, cressanyl ester A, B, C, D, E, F and G were isolated from the aerial parts of the plant[54-56].

Chloroform soluble fraction of *Cressa cretica* produced seven compounds: triacontanoic acid, 24-hydroxy-4 octacosanone, 24-nor-12-ursene, β -amyrin, stigmasterol, ursolic acid and stigmasterol 3-O- β -D-glucoside[46, 57]. It also contained syringaresinol-β-d-deglucoside, triacontanoic acid, β-amyrin, edible fixed oil, quercetin, n-octacosanol, scopoletin and umbelliferone[46].

Sunita and Jha isolated nine compounds included three coumarins, four flavonoids along with two phytosterols from *Cressa cretica*. Their structure established as coumarin, umbelliferone, daphnetin, quercetin, kaempferol, quercetin 3-O-b-D-glucoside, quercetin-3-O-a-L-rhamno-(1→6)-b-D-glucoside, stigmasterol and b-sitosterol[58].

Cresoside, a new coumaranochromone glycoside was isolated from fruits of *Cressa cretica*[59]. Syringaresinol-beta-D-glucoside was also isolated from *Cressa cretica*[60].

The extract of *Cressa cretica* was also shown to have high phenolic content, 99.09±0.10 μg/mg[61].

The aerial parts of *Cressa cretica* yielded five flavonoids that were identified as quercetin, quercetin-3-*O*-glucoside, kampferol-3-*O*-glucoside, kampferol-3-*O*-rhamnoglucoside, and rutin[62].

It was also reported the fruits of *Cressa cretica* was a potential source of edible oil. The oil of *C cretica* was free from any undesirable components and could safely be recommended for human consumption[63]. However, saturated /un-saturated fatty acid fractions (%) constituents of *Cressa cretica* oil were: total saturated were 35.76% [dodecanoic acid methyl ester (lauric) 0.00, tetradecanoic acid methyl ester (myristic) 0.00, pentadecanoic acid methyl ester 0.00, hexadecanoic acid methyl ester (palmitic) 25.75±7.82, octadecanoic acid methyl ester (stearic) 8.267±0.16, non-adecanoic acid methyl ester 0.00, eicosanoic acid methyl ester (arachdic) 1.19±0.03, heneicosanoic acid methyl ester 0.00, docosanoic acid methyl ester (behenic) 0.287±0.01, tricosanoic acid methyl ester 0.00, tetracosanoic acid methyl ester (lignoceric) 0.287±0.05 and hexacosanoic acid methyl ester (cerotic) 0.00]; while total unsaturated were 63.45 [9-hexadecenoic acid methyl ester (palmitoleic) 0.127±0.01, 7-hexadecenoic acid methyl ester (palmitoleic) 0.00, 8, 11-octadecadienoic acid methyl ester (linoleic) 62.707±0.87 and 11-eicosanoic acid methyl ester (gadoleic) 0.637±0.01][64].

The concentration of *Cressa cretica* seeds minerals (N, P, K, Ca, Mg and S) were 2.48, 0.38, 0.71, 3.19, 0.21 and 0.18 (%) respectively, while that of (Na, Fe, Mn, Zn and Cu) were 310, 1526, 80, 46 and 15 7 (ppm) respectively[64].

Pharmacological effects:

Bronchodilatory effect:

The effect of ethylacetate fraction (Fr-Et) and methanolic fraction (Fr-Me) obtained from *Cressa cretica* were evaluated in experimental models for bronchodilatory activity and mast cell stabilising activity. The effect of Fr-Et and Fr-Me were studied on acetylcholine and histamine aerosol-induced broncospasm using guinea pigs as an experimental animals. Also, the effects of these fractions were evaluated on the isolated guinea pig tracheal preparations. Besides this, mast cell degranulation effect was assessed using egg albumin and compound 48/80 on rat peritoneal mast cells. Significant increase in preconvulsion time was observed due to pretreatment with the fractions when guinea pigs were exposed to histamine and acetylcholine aerosol. Fr-Et

and Fr-Me significantly increased the preconvulsion in a dose depended manner that suggestive of bronchodilating activity. Fr-Et and Fr-Me exhibited a significant concentration dependant relaxant effect on guinea pig trachea pre-contracted with CCh, K^+ and histamine. The results revealed that Fr-Et was more potent than Fr-Me in relaxing histamine, K^+ and calcium induced contraction than CCh induced contractions. In styding the effect of the fractions in protecting mast cell degranulation, which were elicited by the egg albumin as well as synthetic compound 48/80 revealed that both fractions significantly protect the mast cell degranulation, which release mediators such as histamine and proinflammatory cytokines through various stimuli, in a dose depended manner[65].

Antitussive effect:

The antitussive effect of the plant was evaluated in two different experimental models. The antitussive effect of aerosols of two different concentrations (2.5%, 5%w/v) of methanolic extract of *Cressa cretica* (CME), codeine (0.03g/ml), and normal saline were tested by counting the numbers of coughs produced due to aerosols of citric acid 10 min after exposing the male guinea pigs to aerosols of different plant aerosols. In another set of experiment CME was investigated for its therapeutic efficacy on a cough model induced by sulfur dioxide gas in mice. The results showed significant reduction of cough number obtained in the presence of both concentrations of CME and codeine. The antitussive effect of higher concentration of CME in guinea pigs was significantly ($p<0.01$) greater than those of lower concentration and the prototype antitussive agent codeine phosphate ($p<0.01$). It also exhibited significant anti tussive activity as that of codeine phosphate, in sulfur dioxide gas induced cough model. The extract at 100, 200 and 400 mg/kg orally, showed inhibition of cough by 22.1, 34.35 and 55.44 % within 90 min of performing the experiment[66].

Effects on Reproductive systems: Oral administration of a methanolic extract of *Cressa cretica* (whole plant) at a dose level of 100 mg/kg/day for a period of 60 days led to a significant decrease in the weight of testis, epididymis, seminal vesicle, and ventral prostate. *Cressa cretica* reduced the fertility of male rats by 100%. There was a marked reduction in the number of primary spermatocytes, secondary spermatocyte, and spermatids. Sertoli cell counts were significantly decreased. Leydig cell nuclear area and the number of mature Leydig cells were also significantly decreased. The protein, sialic acid, glycogen, and cholesterol content of the testis, the fructose in the seminal vesicle, and protein and sialic acid in the epididymis were significantly decreased. Serum testosterone levels were also reduced after *Cressa cretica* treatment. The RBC and WBC counts, hemoglobin, hematocrit, blood sugar, serum cholesterol, phospholipids, triglyceride, and HDL-cholesterol were within the normal range[53].

The various fractions (FrI 75:25 $CHCl_3$:CH_3OH, FrII 50:50 $CHCl_3$:CH_3OH and FrIII 25:75 $CHCl_3$:CH_3OH) of the *Cressa cretica* whole plant methanol extract were isolated by column chromatography on silica gel. These fractions were used to evaluate their effects on the reproductive functions in male albino rats. Oral administration of fractions I, II and III to male rats (50mg/rat/day) for a period of 60 days did not cause body weight loss, whereas the weight of testes and accessory sex organs were decreased significantly ($P\leq0.001$). Sperm counts of testes and cauda epididymis as well as cauda epididymal sperm motility was also declined significantly ($P\leq0.001$) in comparison to control rats. The serum testosterone production was reduced in treated male rats. The fertility was decreased by 90% in FrI, 100% in FrII and FrIII treated male rats. Total protein, sialic acid, glycogen content of testes and seminal vesicular fructose content were reduced significantly, whereas testicular cholesterol level was increased significantly. The seminiferous tubular diameter and Leydig cell nuclear area were reduced significantly. The population of spermatogenic cells (spermatogonia, preleptotene, pachytene, secondary spermatocytes and round spermatids) were also reduced significantly in comparison to controls[67].

Cressa cretica was evaluated for male contraceptive activity due to their rich amount of flavonoids (rutin and scopoletin). After 60 days oral administration of *Cressa* constituents, results showed 100% antifertility activity in male rats with the reduction in testosterone levels and spermatogenic elements[68].

Nootropic effect:

The effects of *Cressa cretica* was evaluated in learning and memory in mice. Elevated plus maze and passive avoidance paradigm were utilized to test learning and memory. Two doses (200 and 400 mg/kg, po) of ethanolic extract were administered for 28 successive days in separate group of animals. The dose of 400 mg/kg po, of *Cressa cretica* extract (CCE) significantly improved learning and memory of mice. Furthermore, this dose significantly reversed the amnesia induced by scopolamine (0.4 mg/kg, ip). To find out the mechanism by which CCE exerted nootropic activity, the effect of CCE on whole brain AChE activity was also estimated. CCE decreased whole brain acetyl cholinesterase activity and reduced whole brain MDA and NO levels. The

antioxidant properties and the presence of flavonoids in *Cressa cretica* may be contributing to memory enhancement effect. Accordigly, *Cressa cretica* was a potent candidate for enhancing learning and memory and it would be beneficial for the treatment of amnesia and Alzheimer's disease[69-70].

Antidiabetic effect:

The antidiabetic activity of *Cressa cretica* was evaluated in alloxan induced diabetes in rats. The maximum glucose lowering effect of (11.86%) was observed at 12 hour after the administration of 300mg/Kg . Repeated oral treatment with ethanolic extract of *Cressa cretica* (EECC) (300mg/Kg/day) for two weeks significantly reduced blood glucose, serum cholesterol and improved HDL-cholesterol and albumin as compared to diabetic control group[71].

The antidiabetic potential of methanolic extract of *Cressa cretica* was studied in streptozotocin induced diabetic rats. The methanolic extract of *Cressa cretica* was administered orally at a dose of 100 mg/kg for 15 days to streptozotocin induced diabetic rats. Methanolic extract of *Cressa cretica* produced a significant reduction in fasting blood glucose level in diabetic rats. Significant differences were also observed in body weight in methnolic extract treated diabetic rats, when compared with diabetic control, normal control and standard drug treated rats. The authors postulated that phenolic compounds and flavonoids were responsible for antidiabetic activity[72].

Antibacterial and antifungal effects:

Antibacterial activity of various extracts of *Cressa cretica* and the crude alkaloid solution was tested against four micro organisms (*E. coli, Staphylococcus aureus, Proteus* Spp and *Pseudomonas* spp.). Antibacterial analysis revealed considerable antibacterial activity exerted by all the extracts except hexane extract and in the case of *Proteus* spp the extracts showed greater activity compared to the control. All extracts showed maximum activity against *E. coli*[73].

The antibacterial effect of the different fractions (hexane, ethylacetate and methanol) of the whole methanolic extract of *Cressa cretica* were studied against wide ranges of bacteria (both positive and negative strain) and five fungi *Candida albicans, Candida tropicalis, Aspergillus fumigatus, Aspergillus niger* and *Fusarium oxysporum* by agar disc diffusion method. Among the three fractions, the ethylacetate fraction of *Cressa cretica* showed the highest activity, but among the pathogens highest activity was revealed against *Escherichia coli, Klebsiella pneumoniae* (zone of inhibition diameter was found to be 26 and 31mm, respectively). The ethylacetate fraction was active against both gram positive and gram negative bacterias. *Cressa cretica* showed higher inhibitory activity against the *Aspergillus fumigates***,** *Aspergillus niger* (zone of inhibition diameter was found to be 26 and 22mm, respectively) than the *Candida albicans* and *Candida tropicalis* and, the least activity was recorded against *Fusarium oxysporum*[74].

The antibacterial and antifungal activity of methanolic extract of *Cressa cretica* was studied by cup plate method against various organisms like *E. coli, S aureus, S. typhi, B. subtilis,* and *C. albicans.* 200-800µg/ml of the ethanolic extract showed dose dependent antimicrobial activity , the diameter of zone of growth inhibition (mm) was 25-30 against *E. coli,*15-25 against *S. aureus,* 20-30 against *S. typhi,* 20-25 against *B subtilis,* and 20-25 against *C. albican*[49].

Antifungal activity was exerted by ethanol extract of *Cressa cretica* against *Penicillium citrinum* (32.2 mm) and *Candida albicans* (25.7 mm)[75].

The antifungal activity of crude solvent extract of *Cressa cretica* against the dermatophytic fungi *Aspergillus niger, Aspergillus flavus, Paecilomyces varioti, Microsporum gypseum* and *Trichophyton rubrum* was investigated. The various crude solvent extracts were found to be effective against the test organisms, the chloroform and aqueous extracts appeared to be the most effective antifungal extracts, compared to the ethanol, methanol and ethyl acetate extracts[76].

Anti-inflammatory, antipyretic and analgesic effects:

The methanolic (Fr-Me) and ethyl acetate fraction (Fr-Et) obtained from the aerial parts of *Cressa cretica* exhibited inhibitory effect against acute and chronic models of inflammation (carrageenan-induced paw edema, cotton pellet granuloma, carrageenan air pouch inflammation, vascular permeability and Freuds complete adjuvant induced arthritis models). The fractions also inhibited arachidonic acid and other mediator (histamine, serotonin, prostaglandin E2)-induced paw edema in rats in a dose dependent manner. Moreover, Fr-Me and Fr-Et significantly increased plasma superoxide dismutase, catalase, glutathione and glutathione peroxidase activities. On the contrary, the malonaldehyde (as a measure of lipid peroxidation) level was significantly decreased in comparison with the control group. Also, it was found that Fr-Et reduced the inflammation and revealed the antioxidant activity more significantly than Fr-Me[63].

The analgesic and antipyretic activities of methanolic extract of *Cressa cretica* at different doses (100, 150 and 200 mg/kg) was studied using hot plate, acetic acid induced writhing and yeast induced hyperthermia methods. Methanolic extract of *Cressa cretica* showed significant analgesic and antipyretic activities at the dose of 200 mg/kg in all models studied[77].

Antioxidant effect:

n-Butanol extracts of nine medicinal plants, *Cressa cretica, Ziziphus spinachrist, Acacia tortilis, Tephrosia haussknechti, Aristolochiae bracteolata, Citrullus colocynthis, Teucrium mascatense, Rhazya stricta* and *Nerium oleander*, were screened for their antioxidant activity using phosphomolybdenum complex assays and their radical scavenging activity using DPPH assays. *Cressa cretica* showed high level of DPPH scavenging activities 87.7%[78].

The free radical scavenging activity of *Cressa cretica* was studied on *in vitro* antioxidant models. The antioxidant activity was evaluated by determining the activity of hydrogen peroxide (H_2O_2) radicals scavenging and 1,1-diphenyl-2-picryl hydrazyl (DPPH) assay. In all these models, a significant correlation existed between concentrations of the extract and percentage inhibition of free radicals[61].

The methanolic (Fr-Me) and ethyl acetate fraction (Fr-Et) obtained from the aerial parts of *Cressa cretica* significantly increased plasma superoxide dismutase, catalase, glutathione and glutathione peroxidase activities. On the other hand, the malonaldehyde (as a measure of lipid peroxidation) level was significantly decreased in comparison with the control group[63].

III. CONCLUSION

This review discuss the chemical constituent, pharmacological and therapeutic effects of *Cressa cretica* as promising herbal drug because of its safety and effectiveness.

REFERENCES:

[1] Vickers A. and Zollman C. ABC of complementary medicine Herbal medicine.

[2] 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.

[3] Al-Snafi AE. The pharmacological Importance of *Antirrhinum majus* - A review. Asian J of Pharm Sci & Tech 2015; 5(4): 313-320.

[4] 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.

[5] Al-Snafi AE. The Pharmacological Importance of *Ballota nigra* –A review. Ind J of Pharm Sci & Res 2015; 5(4): 249-256.

[6] Al-Snafi AE. Chemical constituents and pharmacological importance of *Bidens tripartitus* - A review. Ind J of Pharm Sci & Res 2015; 5(4): 257-263.

[7] Al-Snafi AE. The pharmacological activities of *Cuminum cyminum* - A review. IOSR Journal of Pharmacy 2016; 6(6): 46-65.

[8] Al-Snafi AE. Medical importance of *Cupressus sempervirens*- A review. IOSR Journal of Pharmacy 2016; 6(6): 66-76.

[9] Al-Snafi AE. The contents and pharmacology of *Crotalaria juncea*- A review. IOSR Journal of Pharmacy 2016; 6(6): 77-86.

[10] Al-Snafi AE. The medical importance of *Cydonia oblonga*- A review. IOSR Journal of Pharmacy 2016; 6(6): 87-99.

[11] 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.

[12] Al-Snafi AE. Clinically tested medicinal plant: A review (Part 1). SMU Medical Journal 2016; 3(1): 99-128.

[13] Al-Snafi AE. Chemical constituents and pharmacological effects of *Clerodendrum inerme*- A review. SMU Medical Journal 2016; 3(1): 129-153.

[14] Al-snafi AE. Chemical constituents and pharmacological effects of *Citrullus colocynthis* - A review. IOSR Journal Of Pharmacy 2016; 6(3): 57-67.

[15] Al-Snafi AE Medical importance of *Cichorium intybus* – A review IOSR Journal of Pharmacy 2016; 6(3): 41-56.

[16] Al-Snafi AE. Pharmacological importance of *Clitoria ternatea* – A review IOSR Journal of Pharmacy 2016; 6(3): 68-83.

[17] Al-Snafi AE. The medical Importance of *Cicer arietinum* - A review IOSR Journal of Pharmacy 2016; 6(3): 29-40.

[18] Al-Snafi AE. Medical importance of *Antemis nobilis* (*Chamaemelum nobilis*)- A review. Asian Journal of Pharmaceutical Science & Technology 2016; 6(2): 89-95.
[19] Al-Snafi. AE. *Adonis aestivalis*: pharmacological and toxicological activities- A revew. Asian Journal of Pharmaceutical Science & Technology 2016; 6(2): 96-102.
[20] Al-Snafi AE. Chemical constituents and pharmacological importance of *Agropyron repens* – A review. Research Journal of Pharmacology and Toxicology 2015; 1 (2): 37-41.
[21] 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.
[22] 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.
[23] 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.
[24] Al-Snafi AE. Therapeutic properties of medicinal plants: a review of plants with antidiabetic effects (part J of Pharmaceutical Biology 2015; 5(3): 218-229.
[25] 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
[26] 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.
[27] 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.
[28] 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.
[29] 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.
[30] 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.
[31] -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.
[32] 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.
[33] 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.
[34] 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.
[35] 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.
[36] 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.
[37] 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.
[38] 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.
[39] Al-Snafi AE. Medicinal plants with anti-urolithiatic effects (part1). Int J of Pharmacy 2015; 5(2): 98-103.
[40] 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.
[41] Lansdown, R.V. 2013. *Cressa cretica*. The IUCN Red List of Threatened Species. Version 2015.2. www.iucnredlist.org [29 July 2015].
[42] Saxena HO and Brahmam M. The Flora of Orissa. Vol. 3. Bhubaneswar: Capital Business services and consultancy 1995: 1563.
[43] Warrier PK, Nambier VP and Ramankutty C. Indian medicinal plants a compendium of 500 species. Vol. 1. New Delhi India, CSIR 1990: 219.
[44] Prajapati ND, Purohit SS, Sharma AK and Kumar T. A handbook of medicinal plants, a complete source book Agrobios. India, Eastern Book Corporation 2004: 173.
[45] Alvarez Cruz NS. *Cressa cretica* L. In: Schmelzer, GH & Gurib-Fakim A (Eds). Medicinal plants/ Plantes médicinales 2. PROTA, Wageningen, Netherlands 2013.
[46] Rani S, Chaudhary S, Singh P, Mishra G, Jha KK and Khosa RL. *Cressa cretica* Linn: An important medicinal plant- A review on its traditional uses, phytochemical and pharmacological properties. Journal of Natural Product and Plant Resources 2011; 1(1): 91-100.

[47] Verma N, Jha KK, Sharma R, Chaudhary S, Singh AK and Kumar A. Biological properties, phytochemistry and traditional uses of Rudravanti (Cressa cretica): A review. Pharma Tutor 2014; 2(8): 154-161.
[48] Sunita P, Jha S and Pattanayak SP. Pharmacognostic studies on leaf and stem of *Cressa cretica Linn.* IJPSR 2011; 2(4): 849-855.
[49] Vite MH, Grampurohit ND, Nangude SL, Gaikwad DD, Aher NB, Jadhav MS and Shelke SJ. Pharmacognostic profile and antimicrobial potential of fruits of *Cressa cretica* L. International Journal of Phytopharmacy Research 2012; 3(2): 72-75.
[50] Khare P, Chaudhary S, Kumar A, Yadav G and Thakur N. A study on the standardization parameters of a halophytic plant (*Cressa cretica* L.). Middle-East Journal of Scientific Research 2013; 15 (10): 1472-1477.
[51] Chaudhary S, Khosa RL, Priyank and Rani S. A report on pharmacognostical and quality control parameters of stem and root of *Cressa cretica* Linn, convolvulaceae. Journal of Pharmacy Research 2012; 5(1): 616-621.
[52] Chaudhary S and Khosa RL. Evaluation of antidiabetic activity of *Cressa cretica* Linn in alloxan induced diabetes in rats. Pharmacologyonline 2010; 31: 81-188.
[53] 53-Gupta RS and Kachhawa JBS. Effect of *Cressa cretica* Linn. methanolic extract on testicular function of albino rats. Pharmaceutical Biology 2006; 44(5): 382-88.
[54] Ramachandrum R, Ali M, Mir SR. Isolation and characterization of aliphatic constituents from *Cressa cretica* aerial parts. J Saudi Chem Soc 2004; 8:523-530.
[55] Ramachandran R and Ali M. Isolation and characterization of acyclic terpenic constituents from *Cressa cretica* aerial parts. Journal of Medicinal and Aromatic Plant Sciences. 2003; 25(1), 81-90.
[56] Tiwari HP and Kakkar A. Phytochemical examination of *Cressa cretica* Linn. (Rudanti). Journal of the Indian Chemical Society 1990;67(9): 785.
[57] Hussain S, Ahmed E, Malik A, Jabber A and Arshad M. Phytochemical studies on *Cressa cretica*. J Chem Soc Pak 2005;27(3):296-298.
[58] Sunita P and Jha S. Constituents of *Cressa cretica* L., a halophytic plant. Asian Journal of Chemistry 2012; 24(6): 2730-2732.
[59] Ahmed B. Cresoside: a new coumaranochromone glycoside from fruits of *Cressa cretica* Linn Indian Journal of Natural Products 1998; 14(2): 29-32.
[60] Shahat AA, Abdel-Azim NS, Pieters L and Vlietinck AJ. Isolation and NMR spectra of syringaresinol-beta-D-glucoside from *Cressa cretica*. Fitoterapia 2004; 75(7-8): 771-773.
[61] Pryianka L, Partap S, Verma M and Jha KK. *In vitro* antioxidant activity of plant extract of *Cressa cretica*. Der Pharmacia Lettre 2015; 7 (5):28-32.
[62] Shahat AA, Abdel-Azim NS, Pieters L and Vlietinck AJ. Flavonoids from *Cressa cretica*. Pharmaceutical Biology 2004; 42(4-5): 349-352.
[63] Sunita P, Jha S and Pattanayak SP. Anti-inflammatory and *in vivo* antioxidant activities of *Cressa cretica* Linn., a halophytic plant. Middle-East Journal of Scientific Research 2011; 8 (1): 129-140.
[64] Weber DJ, Ansari R, Gul B and Khan MA. Potential of halophytes as source of edible oil. Journal of Arid Environments 2007; 68 : 315–321.
[65] Priyashree S, Jha S and Pattanayak SP. Bronchodilatory and mast cell stabilising activity of *Cressa cretica* L.: evaluation through *in vivo* and *in vitro* experimental models. Asian Pac J Trop Med 2012;5(3):180-186
[66] Sunita P, Jha S and Pattanayak SP. *In vivo* antitussive activity of *Cressa cretica* Linn. using cough model in rodents. Pharmacognosy 2009; 1(3): 157-161.
[67] Gupta RS and Kachhawa JBS. Contraceptive evaluation of isolated fractions of *Cressa cretica* (L.) whole plant methanol extract in male albino rats. Planta Med 2008; 74(9): PA324.
[68] Kachhawa JBS and Gupta RS. Male contraceptive activity of phytochemical constituents of *Cressa cretica* (convolvulaceae). Planta Med 2010; 76: P79.
[69] Khare P, Yadav G, Chaudhary S and Singh L. Investigation on protective effects of *Cressa cretica* extract in scopolamine- induced memory impairment. International Journal of Pharmacology and Toxicology 2014; 2(1): 13-16.
[70] Khare P, Yadav G, Chaudhary S, Singh L, Yadav G and Verma S. Evaluation of nootropic activity of *Cressa cretica* in scopolamine- induced memory impairment in mice. International Journal of Pharmacology and Toxicology 2014; 2 (2): 24-29.
[71] Chaudhary S, Khosa RL, Jha KK and Verma N. Evaluation of Antidiabetic activity of *Cressa cretica* Linn in alloxan induced diabetes in rats. Pharmacologyonline 2010; 3: 181-188.

[72] Verma N, Jha KK, Chaudhary S, Garg V, Ahmad S and Kumar U. Assessment of antidiabetic potential of *Cressa cretica* Linn in streptozotocin-induced diabetic rats. International Journal of Advance Research and Innovation 2014; 2(1): 181-184.

[73] Suganthi G, Sripathy SK and Manian K. HPTLC and antibacterial analysis of extracts of *Cressa cretica Linn*. Ancient Science of Life 2008; XVII (3):1-14.

[74] Sunita P, Jha S, Pattanayak SP , and Mishra SK. Antimicrobial activity of a halophytic plant *Cressa cretica* L. J Sci Res 2012; 4 (1): 203-212.

[75] Mandeel Q and Taha A. Assessment of *in vitr*. antifungal activities of various extracts of indigenous Bahraini medicinal plants. Pharmaceutical Biology 2005; 43(4): 340-348.

[76] Pirzada A J, Shaikh W, Ghani KU and Laghari KA. Study of antifungal activity and some basic elements of medicinal plant *Cressa cretica* Linn against fungi causing skin diseases. Sindh University Research Journal (Science Series) 2009; 41(2):15-20.

[77] Verma N, Kumar U, Jha KK, Garg V and Singh AK. Analgesic and antipyretic activity of methanolic extract of *Cressa cretica* Linn. The Pharma Research 2015; 13(1): 1-9.

[78] Al-Busafi S, Al-Riyami M, Al-Ouwaisi K and Hisham A. Screening of antioxidant and radical scavenging activities of some Omani medicinal plants. SQU Journal For Science 2007; 12 (1): 1-6.