IOSR Journal Of Pharmacy *www.iosrphr.org*
(e)-ISSN: 2250-3013, (p)-ISSN: 2319-4219
Volume 9, Issue 6 Series. II (June 2019), PP. 43-50

Pharmacological and Therapeutic Effects of *Lallemantia Royleana*- A Review

Ali Esmail Al-Snafi
Department of Pharmacology, College of Medicine, Thi qar University, Iraq.
Corresponding Author: Ali Esmail Al-Snafi

Abstract: The chemical analysis of Lallemantia royleana seed showed that the seeds contained: protein 25.60%, fat 18.27%, fiber 1.29%, alkaloids, anthraquinones, flavonoids, glycosides, pholobtannin tannins, volatile oils, mixed fatty acids and terpenoids. It exerted many pharmacological effects included antimicrobial, antioxidant, antidepressant, anxiolytic, sedative, antiemetic, hypolipidemic, protective and many other pharmacological effects. The current review discussed the Lallemantia royleana as a beneficial medicinal plant.

Keywords: Lallemantia royleana, constituents, pharmacology

Date of Submission: 22-06-2019 Date of acceptance: 10-07-2019

I. INTRODUCTION

Plants generally produce many secondary metabolites which are bio-synthetically derived from primary metabolites and constitute an important source of chemicals which are used as pharmaceuticals, agrochemicals, flavours, fragrances, colours, biopesticides and food additives. Recent reviews revealed that the medicinal plants possessed central nervous[(1)], cardio-vascular[(2)], antioxidant[(3)], reproductive[(4-5)], gastro-intestinal[(6-7)], respiratory[(8)], antidiabetic[(9-10)], antimicrobial[(11-12)], antiparasitic[(13-14)], dermatological [(15-16)], anticancer[(17-18)], anti-inflammatory, antipyretic and analgesic[(19-20)], immunological[(21-22)], hepato and reno-protective[(23-25)] and many other pharmacological effects. The chemical analysis of *Lallemantia royleana* seed showed that the seeds contained: protein 25.60%, fat 18.27%, fiber 1.29%, alkaloids, anthraquinones, flavonoids, glycosides, pholobtannin tannins, volatile oils, mixed fatty acids and terpenoids. It exerted many pharmacological effects included antimicrobial, antioxidant, antidepressant, anxiolytic, sedative, antiemetic, hypolipidemic, protective and many other pharmacological effects. The current review will discuss the chemical constituents and pharmacological effects of *Lallemantia royleana* as a beneficial medicinal plant.

Plant profile:
Synonyms:
Dracocephalum inderiense, *Dracocephalum royleanum* and *Nepeta erodiifolia*[(26)]
Taxonomic classification:
Kingdom: Plantae, **Division**: Magnoliophyta, **Class**: Magnoliopsida, **Order**: Lamiales, **Family**: Lamiaceae, **Genus**: *Lallemantia*, **Species**: *Lallemantia royleana*.
C**ommon names:**
Arabic: Rehanaberry, balango; **English**: Lady's mantle, balangu; **Hindi**: Tukhm-e-balanga; **Pakistan**: tukhme balangu, tukhmalanga; **Unani:** Baalango, Tukhm-e-Baalango; **Urdu**: Balangushirazi[(27-29)]**.**
Distribution:
It is distributed in **Asia**: Armenia, Azerbaijan, China, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Afghanistan , India, Pakistan, Syria, Iraq, Iran, Russian Federation-Western Siberia, and in **Europe**: Russian Federation-European part [(27, 30)].

II. Description

It was an annual, unbranched, or branched from the base. Stems erect, quadrangular, 5-30 cm, with a dense indumentum of short eglandular retrorse hairs, leafy. Leaves simple, 15-20 x 7-15 mm, oblong-obovate, crenate, cuneate, below with short eglandular hairs and scattered sessile oil globules; petiole up to 15 (-20) mm. Inflorescence starting from near base of stem; verticillasters in axils of leaves, numerous, 6-8 flowered, distant or contiguous; bracts several, linear-oblong as long as or longer than calyx, sessile or shortly petiolate, cuneate, with marginal awns 2-4 mm long. Calyx tubular, 6-7 mm, veined or ribbed, with short glandular spreading hairs and a few sessile oil globules; upper lip with 3 ovate obtuse lobes; lower lip with 2 narrower lobes; all shortly

acuminate; teeth clearly convergent in fruit and closing the mouth. Corolla pale lilac, blue to whitish pink, 7-8 mm, slightly longer than calyx; upper lip 1.5 mm long, dearly shorter than lower lip[31].

Traditional uses:

Seeds were used as cooling, diuretic, sedative; as a soothing agent during urinary troubles, fever, common cold, intestinal troubles. It was also used as cephalic astringent, cardiac tonic, carminative and for cough. A poultice of seeds was applied to abscesses, boils and inflammations. In Ivory Coast, Burkina Faso, Gabon and Tanganyika, different parts of the plant were used for the treatment of intercostals pain, rheumatic pain and fever. The leaf and root decoctions were used to treat pneumonia[28, 32-33].

Muslim used its seeds in drinks as flavoring, cooling, soothing and sedative. Seeds also applied as one composition of herbal mixtures for anxiety and depression disorders. Seeds mucilage also applied as a liniment for skin complications. The seeds were used in Iranian traditional medicine as diuretic, tonic, aphrodisiac, and antitussive and for the treatment of various nervous, hepatic, and renal disorders [27, 34-36].

Chemical constituents:

The chemical analysis of *Lallemantia royleana* seed showed that the seeds contained: dry matter 92.75%, ash 3.63%, crude protein 25.60%, crude fat 18.27%, crude fiber 1.29%, NDF (insoluble fiber in neutral detergent) 30.67% and ADF (insoluble fiber in acidity detergent) 47.80%[37].

However, Farahnaky *et al*., showed that the whole seeds contained moisture 6.05 ± 0.06, protein 2.93 ± 0.20, fat 0.30 ± 0.06, ash 2.98 ± 0.23, fiber 24.24 ± 0.11 and total carbohydrate 87.74 ± 0.55%[38].

The highest values of volatile oil percentage, volatile oil yield per hectar, specific gravity, density and refractive index of the seed oil of *Lallemantia royleana* reached 2.75%, 14.24/ha, 0.980 mg/microliter, 0.941 mg/microliter and 1.520 degree respectively[39].

The preliminary phytochemical investigation of the methanolic extract of seeds of *Lallemantia royleana* showed that the seeds extract contained alkaloids, anthraquinones, flavonoids, glycosides, pholobtannin tannins, volatile oils, mixed fatty acids and terpenoids[40-41].

Seed oil contained 19.26%. fatty acid, 90.71% of them were unsaturated fatty acids (USFA) and 9.29% saturated fatty acids, linolenic acid, oleic acid and palmitic acid were the predominant acids in PUSFA, MUSFA and SFA seed oil, respectively. Seed oil also contained 427.8 ppm tocopherols and 210 ml/l polyphenols[42].

The oils of the aerial parts of *Lallemantia royleana*, grown in Isfahan Province, Iran were analyzed by GC and GC–MS. Forty-six compounds, constituting 94.5% of the total components were identified. The components of *Lallemantia royleana* aerial parts oil (%) were: tricyclene 1.0, α-pinene 0.3, 1-octen-3-ol 0.1, 6-methyl-5-hepten-2-one 0.9, 3-octanone 0.5, 2-octanone 0.1, β-myrcene 2.8,3-octanal trace, α-phellandrene 0.3, δ-3-carene 3.1, α-terpinene 2.0, ρ-cymene 1.9, limonene 5.7, benzyl alcohol 1.6, 1,8-cineole 1.8, β-*cis*-ocimene 0.8, β-*trans*-ocimene 7.4, γ-terpinene 1.1, isobutanol 0.9, terpinolene 2.7, butanol 0.2, dehydro-sabina ketone 0.5, *iso*-3-thujanol 0.7, sabina ketone 0.6, 3-thujene-2-one 7.8, myrtenal 1.7, myrtenol 0.2, verbenone 16.4, *trans*-carveol 9.8, *cis*-sabinene-hydrate acetate 0.2, *cis*-carveol 4.8, *trans*-sabinene-hydrate acetate 0.5, *trans*-sabinyl acetate 0.5, carvacrol 1.5, *iso*-dihydrocarvyl acetate trace, α-cubebene 0.8, α-longipinene 0.1, β-bourbonene 2.7, β-cubebene 8.9, α-*cis*-bergamotene trace, β-caryophyllene 0.6, α-*trans*-bergamotene 0.1, β-*cis*-farnesene trace, β-*trans*-farnesene trace, spathulenol 0.3 and α-muurolol 0.6%[35].

Sharifi-Rad *et al*., investigated the volatile constituents of the aerial parts of *Lallemantia royleana* using gas chromatography and gas chromatography–mass spectrometry. Thirty-seven compounds were identified and the main constituents were *trans*-pinocarvyl acetate (26.0%), pinocarvone (20.0%), β-pinene (1.5%), (*E*)-β-ocimene (4.1%), terpinolene (1.1%), linalool (3.4%), *trans*-pinocarveol (1.6%), 3-thujen-2-one (5.1%), myrtenal (1.5%), verbenone (7.1%), *trans*-carveol (5.3%), *cis*-carveol (3.5%), pulegone (4.4%), carvacrol (1.6%), dihydrocarvyl acetate (2.5%) and β-cubebene (2.1%)[43].

The *Lallemantia royleana* seed mucilage contained 75.87-76.74% carbohydrate, 2.71-3.86% protein, 8.24-9.92% ash, 8.51-9.48% moisture and 20.33% uronic acids. It was with high molecular weight (1.19×10^6Da) polysaccharide, composed of galactose (33.54-36.28%), arabinose (35.96-37.88%), rhamnose (15.18-18.44%), xylose (6.02-7.38%) and glucose (4.11-5.20%)[44-45].

A water-soluble polysaccharide was isolated from the seeds of *Lallemantia royleana* It contained 8.2% moisture, 13.1% ash, 1.6% protein and 77.1% carbohydrate. Analysis showed that it contained arabinose, rhamnose, mannose, fructose, galactose, α-and β-d-glucose, glucuronic acid, galacturonic acid, and glucosamine. ^{1}H, ^{13}C and COSY NMR spectroscopy demonstrated the presence of (1 → 4)-linked-α-D-GalpA, (1 → 3)-linked-β-D-Galp, (1 → 6)-linked-β-D-Galp, (1 →)-β-L-Arap, (1 → 2)-linked-α-L-Rhap and (1 → 3)-linked-β-L-Arap in the polysaccharide sequence[46].

The water-extractable hemicelluloses from seeds of *Lallemantia royleana* was investigated. It appeared as branched hemicelluloses, monosaccharide and elemental analysis of the hemicelluloses obtained from

Lallemantia royleana showed the presence of arabinose 29.44 ± 0.31, galactose 1.41 ± 0.02, rhamnose 69.74 ± 0.51, galacturonic acid 1.82 ± 0.24 % of the total monosaccharides on anhydrous basis. The mass spectrometric study showed presence of b-1,2-linked rhamnose and b-1,3-linked arabinose units in the main chain with arabinose attached to the main chain through β-1,3-linkage[47].

The total phenolic content of *Lallemantia royleana* seeds was estimated using Folin-Ciocalteu method. Total phenolic content was 25.3 mg as gallic acid equivalent/g extract[34]. However, the *Lallemantia royleana* seed mucilage total phenolic content and antioxidant activity (IC_{50}) were equal to 82.56±1.6μgGAE/mg and 528.54±0.35μg/ml, respectively[44].

Pharmacological effect:

Antimicrobial effects:

The antibacterial activity of *Lallemantia royleana* seeds extracts was evaluated by using diffusion method at three different concentrations (100, 50 and 10 mg/ml) against *Staphylococcus aureus, Enterobacter cloacae* (IARS 7), *Pseudomonas aeruginosa* (IARS 9) and *Escherichia coli* (IARS 3). Except aqueous extracts, all organic extracts of *Lallemantia royleana* seeds (methanol, ethanol and chloroform) displayed significant anti-bacterial activity against all the tested bacteria. The chloroform extract exhibited highest anti-bacterial activity (diameter of zone of inhibition= 10.67 ± 1.44, 11.83 ± 3.79, 14.00 ± 1.5 and 14.67 ± 0.58 mm against *P. aeruginosa, E. coli, E. cloacae* and *S. aureus*, respectively) at a concentration of 100 mg/m[27].

Antibacterial screening of *Lallemantia royleana* essential oil showed that it significantly inhibited the growth of *Staphylococcus aureus*, *Bacillus subtilis*, *Klebsiella pneumonia* and *Pseudomonas aeruginosa* ($p < 0.05$). MICs for *Staphylococcus aureus*, *Bacillus subtilis* and *Klebsiella pneumonia* were 5.6, 4.8 and 3.5 μg/ml, respectively. The antifungal screening of the essential oil of *Lallemantia royleana* showed that the oil significantly inhibited the growth of *Candida albicans* and *Aspergillus niger* (MIC = 3.1 and 2.5 μg/ml, respectively)[43].

The effect *Lallemantia royleana* seed mucilage edible coating on population of microbial pathogens (total viable count, psychrotrophic bacteria, *Escherichia coli*, *Staphylococcus aureus* and fungi), chemical changes (thiobarbituric acid, peroxide value and pH) and sensory attributes (color, odor and total acceptability of the beef slices at 4 °C for 18 days) were determined. *Lallemantia royleana* seed mucilage edible coating extended the microbial shelf life, oxidative stability and sensorial acceptability of beef[44].

The antibacterial activities of essential oils from different Iranian medicinal plants were evaluated against TEM gene positive ESBL-producing *Escherichia coli* strains isolated from urine samples of patients with urinary tract infections. The essential oils of the aerial parts of *Lallemantia royleana* displayed high inhibitory effects against ESBL-producing *Escherichia coli* strains with MIC of 1 mg/ml[48].

The methanolic seed extract of *Lallemantia royaleana* (100, 200, 300 and 500 μg) was tested against [*Aspergillus flavus* (NCIM 524), *A. niger* (NCIM 773), *A. parasitic* (NCIM 898), *Candida albicans* (NCIM 3471) and *Saccharomyces cervisiae* (NCIM 3090)**].** Almost all the fungal strains growth was inhibited by the crude plant extract. The methanolic seed extract of *Lallemantia royaleana* showed inhibition in the growth of *Aspergillus flavus* and *Aspergillus parasiticus* at 200 μg concentration and more. *Saccharomyces cervisiae* growth was inhibited at 100 μg concentration, while the growth of *Aspergillus niger* was inhibited at 500 μg concentration. The *Candida albicans* strain showed significant growth inhibition in the presence of methanolic extract of *Lallemantia royleana* seed. The zone of inhibition was 6 mm, 8 mm, 12 mm and 14 mm at 100, 200, 300 and 500 μg concentrations of methanolic seed extract respectively. The antibacterial study of The methanolic seed extract of *Lallemantia royleana* showed that *Bacillus cereus, Bacillus subtilis, Salmonella typhinurium* and *Staphylococcus epidermidis* were the most susceptible pathogens ($MIC_{50} \leq 2$μg/ ml), followed by *Staphylococcus aureus, Proteus vulgaris, Klebsiella pneumonia, Psuedomonas aeroginosa* and *Escherichia coli* respectively[49].

The essential oils from *Lallemantia royleana* were screened for their inhibitory effect against herpes simplex virus type 1 (HSV-1) *in vitro* on Vero cell line CCL-81-ATCC using a plaque reduction assay. Results showed that the inhibitory concentration (IC_{50}) was determined at 0.011% for *Lallemantia royleana* oil with a high selectivity index (6.45)[50].

Antioxidant effect:

The antioxidant effect of the methanolic extract of seeds of *Lallemantia royleana* was investigated using *in vitro* methods. The crude methanolic extract of *Lallemantia royleana* seeds showed IC_{50} value of 140.53 ± 4.22 μg/ml by DPPH method and 576.5 ± 0.00 μg/ml by hydrogen peroxide method, while, the standard BHT showed an IC_{50} value of 43.40 ± 1.30 μg/ml by DPPH method and IC_{50} value of 26.16 ± 0.351μg/ml by hydrogen peroxide method[40].

The antioxidant activity of *Lallemantia royleana* seeds hydro- alcoholic extract was estimated by 2,2-diphenyl-1-picrylhydrazyl (DPPH) and ferric reducing antioxidant power (FRAP) assays. *Lallemantia royleana*

seeds hydro- alcoholic extract possessed radical scavenging activity with IC_{50} value of 300 µg/ml. However, FRAP assay showed no significant results[34].

In studying of antioxidant effects of *Lallemantia royleana*, the methanolic seed extracts exhibited 61.30 ± 0.234 and 3.44 ± 0.376 percent inhibition, at the concentration of 1000 µg/ml and 1.95 µg/ml respectively, by hydrogen peroxide anti-oxidant method. The IC_{50} value of *Lallemantia royleana* seed extract was 576.50 ± 0.00 µg/ml and the IC_{50} value of BHT was 26.16 ± 0.351 µg/ml. By DPPH radical scavenging assay, the crude methanolic extracts of *Lallemantia royleana* seed extract gave percent inhibition of 68.72 ± 0.236 and 0.57 ± 0.197 at 1000 and 1.95 µg/ml respectively**.** The IC_{50} value of *Lallemantia royleana* seed extract was 140.53 ± 4.22 µg/ml and the IC_{50} value of BHT was 43.40 ± 1.307 µg/ml. The total anti-oxidant capacity of the methanolic crude plant extracts and BHT determined by phosphor-molybdenum method revealed that the percentage inhibition values of the *Lallemantia royleana* crude methanolic seed extracts ranged between 66.66 ± 2.309 and 1.33 ± 2.309 percent, at the concentration of 1000 µg/ml and 1.95 µg/ml respectively. IC_{50} value of *Lallemantia royleana* was 187.46 ± 0.55 µg/ml and the IC_{50} value of BHT was 124.25 ± 3.04 µg/ml[51].

Antidepressant effect:

The antidepressant effect of methanolic extract of *Lallemantia royleana* seeds (25, 50, 75mg/kg, orally) was investigated in mice with acute mild stress model of depression using modified forced swimming test. All doses of the methanolic extract of *Lallemantia royleana* seeds produced significant reduction in % immobility. However, the percentage of immobility time was significantly reduced at 50 mg/kg, (56.67%, $p<0.01$)[52].

Anxiolytic and sedative effects:

The anxiolytic and sedative like effects of methanolic extract of *Lallemantia royleana* seeds (75, 100, 250 and 500 mg/kg, orally) was studied in male mice. Behavioral tests such as open field, hole-board, elevated plus maze, light-dark box and staircase paradigm were used to screen anxiolytic activity. Diazepam (1 mg/kg, ip) was employed as standard. Behavioral tests for anxiety showed maximum increase in anxiolytic parameters at the dose of 250 mg/kg ($p<0.01$) without altering exploratory behavior i.e. number of head-dips 54 ± 3.1, time spent in open arm percent 70± 2.8, entries in open arm percent 67.3±1.2, percent time spent in light box 62± 1.5 and number of stairs ascend 16 ±2.1[53].

Hypolipidemic activity:

The hypolipidemic activities of *Lallemantia royleana* was studied in rabbits fed diets supplemented with cholesterol (0.5%) for 12 weeks to evoke hypercholesterolemia. Hypercholesterolemic rabbits were treated with different doses of whole *Lallemantia royleana* seeds (0, 5, 10, and 20%) for 12 weeks. The serum total cholesterol and triglyceride decreased in all groups treated with *Lallemantia royleana* seeds ($p<0.05$), however, *Lallemantia royleana* seeds increase of atherogenic index in all treated groups[54].

Antiemetic activity:

The antiemetic activity of ten aromatic medicinal plants including *Lallemantia royleana* leaves ethanol extracts was studied using chick emetic model at a dose of 150 mg/kg bw, orally. The extracts decreased in retches induced by copper sulphate pentahydrate given orally at a dose of 50 mg/kg bw and showed comparable antiemetic activity to domperidone (mean number of retches 11.16 ± 1.17 compared with 13.5±1.02 for domperidone and inhibition of emesis 83.61% compared with 80.18 for domperidone)[55].

The protective activity:

The protective efficiency of Khamira (a Unani formulation contained *Lallemantia royleana*) was studied using isoproterenol (ISO) induce toxicity in simian virus derived murine endothelial cell line (SVEC) cells. Khamira was nontoxic to SVEC cells up to a concentration of 20 mg/ml, after this concentration cells were unable to survive. 150 µM concentration of isoproterenol induces mild lethality and higher concentrations leading to increased toxicity and induced death. Khamira co-treatment but not pre-treatment was able to maintain the sufficient endogenous antioxidant status that was useful to rescue cells from ROS or free radicals. Khamira might be acting either on signalling events prior to ROS or after ROS generation[56].

Mucilage in pharmaceutical formulations and as food additives:

Natural gums and mucilage have been widely explored as pharmaceutical excipients such as thickeners, suspending agents, emulsifying agents, and binders. Mucilage isolated from the seeds of *Lallemantia royleana* showed a great swelling property and was non irritating to the mucosal membrane and can act as a potential good candidate for various pharmaceutical formulations for its high swellability on coming in contact with water. It can be used as a thickening agent, suspending agent or as a super-disintegrant in formulations[57].

Lallemantia royleana seed gum solution was compared with Tragacanth gum, CMC, Na-alginate and Arabic gum at 0.4 % (w/w) concentration. The highest consistency coefficients were recorded for both *Lallemantia royleana* seed gum and Tragacanth gum. It was evident that the apparent viscosity of all samples decreased with increasing shear. *Lallemantia royleana* seed gum created solutions with a viscosity similar to CMC and Tragacanth gum and higher than Na-alginate and Arabic gum. Accordingly, *Lallemantia royleana* seed gum could be suitable for application as a thickening agent[38].

The mucilage from the seeds of *Lallemantia royleana* was extracted and subjected to pre-formulation study for evaluation of its suitability for use as suspending agent. The suspension of furosamide prepared with 1.5 % w/v of the extracted mucilage was found to be ideal and comparable with the other two preparations of xanthan gum 0.35% w/v and chitosan 1.5% w/v. The mucilage was white in color and the average yield of dried mucilage obtained from *Lallemantia royleana* nutlets was 14 % w/w of the seeds used. It was sparingly soluble in water but swells in contact with it, giving a highly viscous solution. It was slightly acidic to neutral. It exhibited high viscosity profile and exhibited better mucoadhesive property[58].

Balangu mucilage was also used as a gel supplement, and natural matrix for sustained release of drugs. The anesthetic action of gel prepared from Balangu mucilage alone and its mixture with lidocaine hydrochloride were compared with the effect of commercial 2% lidocaine gel using rat tail flick test. The duration and potency of anesthesia induced by gel containing mucilage alone (0.01 g/ml) were identical to commercial 2% lidocaine gel. But, local anesthetic potency and duration of gel made from 2% lidocaine-mucilage gel mixture was significantly higher than commercial 2% lidocaine gel[59].

The powdered seeds and the polymer obtained from aqueous extraction of the seeds were evaluated for use as a super disintegrant in tablet formulation. The powders were evaluated for various properties like swelling index, particle size, their micromeritic properties, density and viscosity. The results revealed that the aqueous acetone extract of the seeds had better swelling characteristics and the tablets prepared from the polymer showed considerably lesser disintegration times than those prepared using powdered seeds[60].

The effect of the gum of *Lallemantia royleana* seed on some physicochemical and sensory characteristics of a typical soft ice cream was investigated. In comparison with carboxymethyl cellulose, *Lallemantia royleana* seed gum did not make a significant difference ($p > 0.05$) to most characteristics and could be used as a suitable stabilizer[61].

Lallemantia royleana seeds was also introduced as yogurt stabilizer instead of gelatin. The yogurt was prepared by the standard method. The tukhm-e-balangu (*Lallemantia royleana*) in the powder form (0.15%, 0.2% and 0.25%), was added to the milk after pasteurization. The yogurt was stored at 4 ± 2^{o}C for 20 days and analyzed for different physiochemical (pH, titratable acidity, synersis, water holding capacity, total solids, viscosity, hardness, fat, protein and ash) and microbiological and sensory attributes at specified day intervals. The utilization of stabilizer and its rate of incorporation affected the given attributes. Among different concentrations of *Lallemantia royleana*, yogurt with 0.25% *Lallemantia royleana* gave best results for physical and chemical parameters but yogurt with 0.20% *Lallemantia royleana* attained highest score for overall sensory acceptability throughout the storage period. Microbiological results were almost comparable with yogurt containing gelatin[29].

Safety and side effects:

The methanolic *Lallemantia royleana* seeds extract was found to be non-toxic at LD_{50}> 5g/kg in mice[53].

III. CONCLUSION

Lallemantia royleana possessed many pharmacological effects included antimicrobial, antioxidant, antidepressant, anxiolytic, sedative, antiemetic, hypolipidemic, protective and many other pharmacological effects. The current review discussed the *Lallemantia royleana* as a beneficial medicinal plant.

REFERENCES

[1]. Al-Snafi AE, Talab TA and Majid WJ. Medicinal plants with central nervous activity - An overview (Part 1). IOSR Journal of pharmacy 2019, 9(3): 52-102.
[2]. Al-Snafi AE. Medicinal plants for prevention and treatment of cardiovascular diseases - A review. IOSR Journal of Pharmacy 2017; 7(4): 103-163.
[3]. Al-Snafi AE. Medicinal plants possessed antioxidant and free radical scavenging effects (part 3)- A review. IOSR Journal of Pharmacy 2017; 7(4): 48-62.
[4]. Al-Snafi AE. Arabian medicinal plants affected female fertility- plant based review (part 1). IOSR Journal of Pharmacy 2018; 8(7): 46-62.
[5]. Al-Snafi AE. Arabian medicinal plants affected male fertility- plant based review (part 1). IOSR Journal of Pharmacy 2018; 8(7): 63-76.
[6]. Al-Snafi AE. Arabian medicinal plants possessed gastroprotective effects- plant based review (part 1). IOSR Journal of Pharmacy 2018; 8(7): *77-95.*

[7]. Al-Snafi AE. Arabian medicinal plants for the treatment of intestinal disorders- plant based review (part 1). IOSR Journal of Pharmacy 2018; 8(6): 53-66.
[8]. 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.
[9]. Al-Snafi AE, Majid WJ and Talab TA. Medicinal plants with antidiabetic effects - An overview (Part 1). IOSR Journal of pharmacy 2019, 9(3): 9-46.
[10]. Al-Snafi AE. Traditional uses of Iraqi medicinal plants. IOSR Journal of Pharmacy 2018; 8 (8): 32-96.
[11]. Al-Snafi AE. Medicinal plants with antimicrobial activities (part 2): Plant based review**.** Sch Acad J Pharm 2016; 5(6): 208-239.
[12]. Al-Snafi AE. Antimicrobial effects of medicinal plants (part 3): plant based review. IOSR Journal of Pharmacy 2016; 6(10): 67-92.
[13]. Al-Snafi AE. Antiparasitic effects of medicinal plants (part 1)- A review. IOSR Journal of Pharmacy 2016; 6(10): 51-66.
[14]. Al-Snafi AE. Antiparasitic, antiprotozoal, molluscicidal and insecticidal activity of medicinal plants (part 2) – plant based review. Sch Acad J Pharm 2016; 5(6): 194-207.
[15]. 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.
[16]. Al-Snafi AE. Arabian medicinal plants with dermatological effects- plant based review (part 1) . IOSR Journal of Pharmacy 2018; 8(10): 44-73.
[17]. Al-Snafi AE. Medicinal plants with anticancer effects (part 2)- plant based review. Sch Acad J Pharm 2016; 5(5): 175-193.
[18]. Al-Snafi AE. Anticancer effects of Arabian medicinal plants (part 1) - A review. IOSR Journal of Pharmacy 2017; 7(4): 63-102.
[19]. Al-Snafi AE. Arabian medicinal plants with antiinflammatory effects- plant based review (part 1). Journal of Pharmacy 2018; 8 (7): 55-100.
[20]. Al-Snafi AE. Arabian medicinal plants with analgesic and antipyretic effects- plant based review (Part 1). IOSR Journal of Pharmacy 2018; 8(6): 81-102.
[21]. 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.
[22]. Al-Snafi AE. Immunological effects of medicinal plants: A review (part 2). Immun Endoc & Metab Agents in Med Chem 2016; 16(2): 100-121.
[23]. Al-Snafi AE and Thwaini MM. Nephro- protective effects of Arabian medicinal plants (part 1). Research Journal of Pharmaceutical, Biological and Chemical Sciences 2018; 9(5): 1504-1511.
[24]. Al-Snafi AE and Thwaini MM. Arabian medicinal plants with hepatoprotective activity (part 1). Research Journal of Pharmaceutical, Biological and Chemical Sciences 2018; 9(5): 1469-1497.
[25]. Al-Snafi AE. Arabian medicinal plants with antiurolithiatic and diuretic effects - plant based review (Part 1). IOSR Journal of Pharmacy 2018; 8(6): 67-80.
[26]. The plant list, *Lallemantia royleana*, http:// www. theplantlist. org/ tpl/ record / kew -107342
[27]. Mahmood S, Hayat MQ, Sadiq A, Ishtiaq S, Malik S and Ashraf M.. Antibacterial activity of *Lallemantia royleana* (Benth.) indigenous to Pakistan. Afri J Microbiol Res 2013;7 (31): 4006-4009.
[28]. Naghibi F, Mosaddegh M, Mohammadi S and Ghorbani A. Labiatae family in folk medicine in Iran: from ethnobotany to pharmacology. Irani J Pharm Res 2005; 2: 63-79.
[29]. Sohail B, Huma N, Mehmood A, Abdullah M and Shah AA. Use of tukhm-e-balangu (*Lallemantia royleana*) as a stabilizer in set type yogurt. Journal of Agroalimentary Processes and Technologies 2014; 20(3): 247-256.
[30]. U.S. National plant germplasm system, *Lallemantia royleana*, https:// npgsweb. ars-grin.gov/gringlobal/taxonomydetail.aspx?21415
[31]. Flora of Pakistan, *Lallemantia royleana*, http://www. efloras.org/ florataxon. aspx? flora_id=5&taxon_id=200019747
[32]. Khare CP. Indian medicinal plants -An-illustrated dictionary. Springer Science and Business Media, LLC 2007: 360.
[33]. Preedy V, Whatson RR and Patel VB. Nuts and seeds in health and disease prevention. 1st Ed. Academic Press, USA 2011.
[34]. Bozorgi M and Vazirian M. Antioxidant activity of *Lallemantia royleana* (Benth.) seed extract. Trad Intrgr Med 2016; 1(4): 147-150.
[35]. Ghannadi A and Zolfaghari B. Compositional analysis of the essential oil of *Lallemantia royleana* (Benth. In Wall.) Benth from Iran. Flavour Frag J 2003; 18: 237- 239.
[36]. Amin GR. Popular medicinal plants of Iran. Publications of Tehran University of Medical Sciences, Tehran 2005: 66-67.

[37]. Razavi SMA, Mohammadi-Moghaddam T and Mohammad-Amini A. Physico-mechanic and chemical properties of balangu seed. Int J Food Eng 2008;4(5): 1-10.
[38]. Farahnaky A, Askari H and Bakhtiyari M. Rheology of balangu Shirazi (*Lallemantia royleana*) seed gum: a high viscosity thickening agent. In: Gums & stabilizers for the food industry 15. Editors: Peter A. Williams and Glyn O. Phillips. RSC press 2009:190-200.
[39]. Abbas IS, Hasan EF and Kashmar AM. The influence plant spacing on growth and volatile oil quantity and quality of belangu plant (*Lallemantia royleana* Wall) as medicinal plant used in traditional medicin in Iraq. Kerbala Journal of Pharmaceutical Sciences 2012; 4(2): 177-182.
[40]. Jasmine F, Shazia M, Ali SM, Masihur R and Huma M. Phytochemical analysis, *in vitro* antioxidant potential and GC-MS of *Lallemantia royleana* seeds. International Journal of Scientific and Research Publications 2016; 6(2): 407-411.
[41]. Khan GI. Medicinal seeds malanga from *Lallemantia royleana* Benth. or *Salvia aegyptiaca* Linn. National Seminar on New Millennium Strategies for Quality, Safety & GMPs of Herbal Drugs/ Products, Lucknow, India. 2003: 155.
[42]. Daneshmandi MS, Afshari RT and Haghighi RS. Identification of chemical and biochemical characteristics of balangu seeds (*Lallemantia royleana* Benth.) Benth.in Wall) under accelerated aging conditions. Iranian Journal of Seed Science and Technology 2017; 6(1): 23-37.
[43]. Sharifi-Rad J, Hoseini-Alfatemi SM, Sharifi-Rad M and Setzer WN. Chemical composition, antifungal and antibacterial activities of essential oil from *Lallemantia royleana* (Benth. in Wall.) Benth. J Food Safety 2015; 35(1): 19-25
[44]. Behbahani BA and Imani Fooladi AA. Shirazi balangu (*Lallemantia royleana*) seed mucilage: Chemical composition, molecular weight, biological activity and its evaluation as edible coating on beefs. Int J Biol Macromol 2018; 114:882-889.
[45]. Razavi SM, Cui SW and Ding H. Structural and physicochemical characteristics of a novel water-soluble gum from *Lallemantia royleana* seed. Int J Biol Macromol 2016; 83:142-151.
[46]. Neda F. Structural elucidation of a water-soluble polysaccharide isolated from balangu Shirazi (*Lallemantia royleana*) seeds. Food Hydrocolloids 2017;72: 263-270.
[47]. Iram F, Massey S, Iqbal MS and Ward DG. Structural investigation of hemicelluloses from *Plantago ovata*, *Mimosa pudica* and *Lallemantia royleana* by MALDI-ToF mass spectrometry. J Carbohydrate Chemistry 2018, doi: 10.1080/07328303.2018.1487973
[48]. Sharifi-Rad J, Mnayer D, Roointan A, Shahri F, Ayatollahi SAM, Sharifi-Rad M, Molaee N and Sharifi-Rad M. Antibacterial activities of essential oils from Iranian medicinal plants on extended-spectrum β-lactamase-producing *Escherichia coli*. Cell Mol Biol 2016; 62 (9): 75-82.
[49]. *Lallemantia royleana*, Chapter 4, http://shodhganga .inflibnet.ac.in/ bitstream/ 10603/ 93051 /5/chapter-%204.pdf
[50]. Sharifi-Rad J, Salehi B, Schnitzler P, Ayatollahi SA, Kobarfard F, Fathi M, Eisazadeh M and Sharifi-Rad M. Susceptibility of herpes simplex virus type 1 to monoterpenes thymol, carvacrol, p-cymene and essential oils of *Sinapis arvensis* L., *Lallemantia royleana* Benth. and *Pulicaria vulgaris* Gaertn. Cell Mol Biol 2017; 63(8):42-46.
[51]. *Lallemantia royleana*, Chapter-5, http://shodhganga.inflibnet.ac.in/ bitstream/ 10603/ 89777/11/chapter-5.pdf
[52]. Hyder N, Naqvi BS, Ishaq H, Usman S, Naqvi AA and Naveed S. Effect of *Lallemantia royleana* seeds Benth (Lamiaceae) seeds using acute mild stress model in NMRI male mice of depression. J Biotech and Biosafety 2016; 4(2): 378-382.
[53]. Hyder N, Musharraf SG and Shyum Naqvi SB. Diazepam-like effects of *Lallementia royleana* Benth. (Lamiaceae) seeds in anxiety disorder. Journal of the Neurological Sciences 2017; 381: 607–608.
[54]. Ghannadi A, Movahedian A and Jannesary Z. Hypocholesterolemic effects of balangu (*Lallemantia royleana*) seeds in the rabbits fed on a cholesterol-containing diet. Avicenna J Phytomed 2015; 5 (3): 167-173.
[55]. Mohtasheemul HM, Salman A, Ziauddin A and Iqbal A. Anti-emetic activity of some aromatic plants. Journal of Pharmaceutical and Scientific Innovation 2012; 1(1): 47-49.
[56]. Kareem AM. Possible protective effect of Unani formulation against isoproterenol induced toxicity in SVEC cells. 2016, doi: https://doi.org/10.1101/062802
[57]. Ali1 S, Parvez N and Sharma PK. Extraction and evaluation of *Lallemantia royleana* mucilage. WJPPS 2016; 5(6): 1056-1066
[58]. Abdulrasool AA, Naseer AA and Rahi FA. Application of seed mucilage extracted from *Lallemantia royleana* as a suspending agent. Iraqi J Pharm Sci 2011; 20(1):8-13.
[59]. Atabaki R and Hassanpour-Ezatti M. Improvement of lidocaine local anesthetic action using *Lallemantia royleana* seed mucilage as an excipient. Iran J Pharm Res 2014; 13(4): 1431-1436.

[60]. Mishra S, Bhandari A, Parvez N and Sharma PK. Extraction of *Lallemantia royleana* seed mucilage as pharmaceutical excipient. World Journal of Pharmaceutical Research 2015; 4(4): 1578- 1589.
[61]. Bahramparvar M, Khodaparast MH and Razavi SM. The effect of *Lallemantia royleana* (Balangu) seed, palmate-tuber salep and carboxymethyl cellulose gums on the physicochemical and sensory properties of typical soft ice cream. International Journal of Dairy Technology 2009, 62(4): 571-576.

Ali Esmail Al-Snafi. "Pharmacological and Therapeutic Effects of Lallemantia Royleana- A Review." IOSR Journal of Pharmacy (IOSRPHR), vol. 9, no. 6, 2019, pp. 43-50