EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Coden USA: EJBPBO
Volume: 13
Issue: 3
Year: 2026

PHYTOCHEMICAL CONSTITUENTS, TRADITIONAL USES AND PHARMACOLOGICAL ACTIVITIES OF FERN ADIANTUM CAPILLUS-VENERIS L.: AN OVERVIEW

***V. S. Undal**

Department of Botany, Ghulam Nabi Azad College, Barshitakali Dist Akola (MS) 444401 India.

***Corresponding Author: V. S. Undal**

Department of Botany, Ghulam Nabi Azad College, Barshitakali Dist Akola (MS) 444401 India.

DOI: https://doi.org/10.5281/zenodo.18795796

How to cite this Article: *V. S. Undal. (2026). Phytochemical constituents, traditional uses and pharmacological activities of fern adiantum capillus-veneris l.: an overview. European Journal of Biomedical and Pharmaceutical Sciences, 13(3), 01–09.

Article Received on 24/01/2026 **Article Revised on 13/02/2026** **Article Published on 01/03/2026**

ABSTRACT

Adiantum capillus-veneris L. is belonging to the family Pteridaceae with several uses in conventional and folk medicine. It is named as "*Pare-siavashan*" in medical and pharmaceutical textbooks of Iranian Traditional Medicine. The leaves, roots, stem of the plant are mostly used in the management of kidney stone, diabetes, fungal infection, thyroid, respiratory diseases and many more disorders. Since of diverse chemical compositions, the herb fronds were assessed for its several pharmacological consequences. Therefore, the present study was done to review the phytochemical constituents, traditional usage and modern pharmacological effects of Maidenhair fern. Scientific records and journals counting Scopus, PubMed, Web of Science, Science direct, medical and pharmaceutical textbooks of conventional medicine as well were searched on *Adiantum capillus-veneris* while making this document without limitation up to 2025. This article briefly assess the traditional facts and ethno medicinal accounts on therapeutic activities of the plant *Adiantum capillus-veneris* Linn. The phytochemical and pharmacological studies of this plant provide a scientific basis for its therapeutic usage. This report also reviews the full investigation prepared on the plant will probably facilitate to its valuable remedies in conventional therapy, and will be the window for its usage in discovery of novel drugs.

KEYWORDS: *Adiantum capillus-veneris*, folk medicine, chemical compositions, conventional medicine.

INTRODUCTION

The *Adiantum capillus-veneris* Linn. (Maidenhair fern) is a clumped fern belonging to Pteridaceae family (TPL, 2013). The herb is generally grown in warm-temperature to tropical, with high humidity content (LH, 2011). The plant is extensively scattered in different provinces such as Southern Europe, Atlantic coast as far as Ire-land, from the south to the southern Alpine valleys region, from the central to the South America, Australia and Iran (LH, 2011, Gruenwald et al. 2008). The *Adiantum capillus-veneris* Linn is a attractive delicate fern of moist places, found predominantly in the western Himalayas, ascending to an altitude of 2400 m, and extending into Manipur. It is widespread in Punjab, Bihar, Maharashtra, and south India. It grows among rocks and on walls (Anonymous, 2003, Chatterjee and Pakrashi, 2005). The *Adiantum* is a genus of about 200 species of ferns in the family Pteridaceae, though some investigators place it in its individual family belonging to the Adiantaceae, *Adiantum capillus veneris* (Sood and Sharm, 2010).

The *Adiantum capillus-veneris* is a woody species with a 35 cm tallness, which has a rhizome. Its dried root is employed as medicine. The bases of its leaves are roofed by wool. This plant occurs in southern Europe, the Alps, and Atlantic Coast as well as in Iran. The plant is, in fact, a kind of perennial species of the maidenhair fern genus that grows in moist and organic material-rich atmosphere as well as close to the streams and rivers, such as wet walls. The plant look like green cilantro (Shirazi et al. 2010). The Maidenhair fern is a resilient, up to 35 cm high plant that has an aromatic smell with a creeping rhizome. The plant fronds are usually double-lined, tender, glabrous, and grow up to 50 cm lengthy. The plant roughly has a shiny black petiole and is covered with hair at the foot. The species has ovate to oblong-ovate leaf blade. The medicinal parts are fronds,

rhizomes, and roots (Gruenwald et al. 2008). Fronds blade up to long 25 cm bi or trip innate, rachis like petiole in morphology, fronds were separated to green leaflets, deltoid or rhomboid, lobbed with toothed border. The venation open dichotomous lacking veinlet's, veins are reach leaflet border. The T. S. of petiole observed circular formed with thick coating of cuticle, consist of single coated epidermal thickened wall cells lacking stomata. Subsequent to epidermis is outer 2-3 layered sclerenchymatous cells and several layered, slim walled regular parenchymatous cells. It distinctly observed endodermis and thin layered pericycle cells. The vascular system consists of solitary VB with twice xylem arms formed Y shaped. The pinnae detected; dermal tissue system comprised of uniseriat upper epidermis with wavy wall, irregular contain chloroplast, with no stomata. Lower epidermis parallel to upper, however contain normocytic buried stomata. Ground tissue system comprised of homogenous mesophyll with closed VB in vascular tissue system (Abbas, and Al-Majmaie, 2023). The synonyms of the plant comprise *Adiantum capillus, A. michelii, A. modestum, A. schaffneri*, and *A. tenerum*. Its most frequent names are avenca and maidenhair fern (Taylor, 2009). The plant favors light (sandy), intermediate (loamy) and profound (clay) soils and requires well-drained soil.

Phytochemistry

The *A. capillus-veneris* generated a broad range of phytochemicals, counting flavonoids, steroids, terpenoids, and phenolic acids (Khodaie et al. 2015). Its phenolics comprises chlorogenic acid, gallic acid, rutin, isoquercetin, kaempferol, kaempferol 3-sulfate, kaempferol 3-glucuronide, astragalin, quercetin 3-O-(6"-malonyl)-D-galactosidase (Singh et al. 2020). The phytochemicals examination exposed alkaloids, cardiac glycosides, steroids, reducing sugars, tannins (Ishaq et al. 2014), triterpenoids such as, 30-normethyl fernen-22-one (capillirone, 1), hopan-3β-ol (capillirol B, 2), 4-α-hydroxyfilican-3-one, 3-β,4-α-dihydroxyfilicane (Haider et al. 2013), isoadiantone, isoadiantol-B, 3- methoxy-4-hydroxyfilicane and 3,4-dihydroxyfilicane, flavonoids such as, quercetin, quercetin-3-O-glucoside and quercetin-3-O-rutinoside (The methanol extracts of *Adiantum capillus-veneris* to recognized 37 bioactive Ibraheim et al. 2011), oleanane compounds such as, olean-18-en-3-one and olean-12-en-3-one (Nakane et al. 2002), beta-sitosterol, stigmasterol and capesterol (Marino et al. 1989) as plant components. The chief compounds were 5-7A-Isoprpenyl-4, 5-Dimethyloctahydro-1h-inden-4yl)-3-methyl-2-penta, n-hexadecanoic acid, gamma-sitosterol, cis-vaccenic acid, 5-7A-Isopropenyl-4, 5-Dimethyl-octahydro-inden-4-yl)-3-methyl-pent-2-EL, Tetrdecanoic acid, Phenanthrene, and 9 dodecyltetradecahydro. The lowest fraction of peak area 0.25% and their compound as 2-methoxy-4-propyl, among these bioactive compounds were counting vitamin E. (Kumar et al. 2014)**.** Chromatographic fractionation of the alcoholic extract of the dried fronds yielded 7 compounds such as isoadiantol-B, 3-methoxy-4-hydroxyfilicane, 3,4-dihydroxyfilicane, and three flavonoids were extracted from the ethyl acetate fraction and recognized as: quercetin, quercetin-3- O-glucoside and quercetin-3-O-rutinoside (rutin). The recognition of the isolated compounds has been established through their physical, chemical and spectroscopic techniques including IR, 1 H NMR, 13C NMR, HSQC, HMBC, NOESY and MS (Ibraheim et al. 2011). Furthermore GC-Mass and its antioxidant activity assessed by DPPH of *Adiantum capillus-veneris* by Khodaie et al. (2015). Examination of yellow colored essential oil yielded 88.22% of entire oil with 67 components. Among recognized phytochemicals, carvone was the major component (31.58%). Additionally, % of carvacrol (13.75%), Hexadecanoic acid (5.88%), Thymol (4.05%), Hexahydrofarnesyl acetone (3.16%) and n-nonanal (2.99%) were more than other identified ingredients. The RC50 of this volatile oil was 0.039 mg/mL. HPLC-DAD-MS recognition of phenolic composites in *Adiantum capillus-veneris* hydromethanolic fraction, revealed the existence of gentisic acid, chlorogenic acid, *p*-coumaric acid, caffeic acid derivative, ferulic acid, kaempferol, quercetin, 3-p-coumaroylquinic acid, apigenin-7-O-glucoside, 3,5-Di-O-caffeoylquinic acid, isorhamnetin-3-O-di-glucoside, quercetin 3-O-glucoside, epica-techin 7-O-rutinoside, kaempferol 3-O-glucoside, ferulic acid derivatives and hydroxycinn-amic derivative. The Quercetin 3-O-glucoside was the main well-known compound followed by 3,5-Di-O-caffeoylquinic acid, hydroxycinnamic derivative and kaempferol 3-O-glucoside (Boukada et al. 2022). The Six flavonoid compounds such as kaempferol, kaempferol-3-O-glycoside, Luteolin, Myricetin, Quercetin, and Rutin were identified in *A. capillus-veneris* L. growing at Gali Ali Beckand from Erbil district and Kalar in Suliamaniyah district sites from Iraqi Kurdistan / Northern Iraq (AL-Khesraji et al. 2017).

In conventional herbal medicinal method, *Adiantum capillus-veneris* was used as expectorant, diuretic, febrifuge, as hair tonic, in chest diseases, in catarrhal infection, to treat hard tumours in spleen, antimicrobial and anticancerous (Puri and Arora, 1961, Singh et al. 1989, Jain et al 1992, Kumar et al. 2003, Santhoshkumar and Nagarajan, 2012). Ethnomedicinally, the genus has been utilized as energizer and diuretic; in treatment of cold, fever, cough and bronchial disorders, as tonic, emollient, purgative, demulcent, common tonic and hair tonic, in addition to skin diseases, tumors of spleen, liver and other viscera (Singh et al. 2008), in management of Jaundice and Hepatitis (Abbasi et al. 2009) and several utilizations (Abbasi et al. 2010, Ahmad et al. 2008, Al-Qura'n, 2009, Camejo-Rodrigues et al. 2003, Dastagir, 2001, De Natale and Pollio, 2007, Guarrera et al. 2008, Hamayun et al. 2006, McGaw et al. 2008, Shinozaki et al. 2008).

Traditional Uses

Several pteridophyte species are used by local populations of the India and China for essential health

and medical concern (Rout et al. 2009). The general practitioners who experienced the Chinese and Unani systems of medicine usually explored ferns and fern allies (Chang et al. 2011, Ahmed et al. 2012). Various decoctions, pastes, liquids and residue are prepared from rhizome, fronds, rachis, spores as well as the entire plant (Sureshkumar et al. 2018). The ferns can be useful externally to take care of injuries, cuts and injuries, as well as in use inside to treat disorders like diarrhea, malaria, gonorrhoea, fever, tumours, ulcers, intestinal worms, diabetes, liver disorder, and membrane diseases (Reinaldo et al. 2015, Sureshkumar et al. 2018). Despite being a lower plant, the pteridophytes are economically extremely significant, since the occurrence of active biomarkers along with remaining phyto-constituents in them. They plentifully generate a different group of plant metabolites such as terpenoids, flavonoids, fatty acids, alkaloids, phenolics, sterols, saponins and others, with terpenoids being the most common (Zangara, 2003, Ho et al. 2011, Zou et al. 2016). These phyto-constituents have antimicrobial, antiviral, anti-tumor, anti-diabetic, anti-inflammatory, antioxidant, antipyretic, anti-helminthic and other curative properties (Hoang and Tran, 2014, Kalpana et al. 2015). The people in different nations have applied the maidenhair fern to diverse health complaints. In Iran, it was frequently used in a conventional technique of medicine, known as "Pare-siavashan," chiefly for lung complaints like asthma, cough, and chest pain, as well as for diuretic, anti-inflammatory, and hair tonic purposes (Qadir et al. 2025).

The plant is a prevalent species with important prospective for medicinal and nutritional purposes. The species of *Adiantum* were consumed for thoracic diseases, coughs, and respiratory infections; as an expectorant; to boost breastfeeding; to carry renal function; for antiparasitic reasons; and for dandruff management. The medicinal properties of the fresh or dried leafy fronds comprise acting as an antidandruff, antitussive, astringent, demulcent, depurative, emetic, galactagogue, mild emmenagogue, emollient, moderate expectorant, febrifuge, laxative, pectoral, refrigerant, refreshment, sudorific, and stimulant. A parallel reason was supplied by the tea prepared from the dried plant fronds (Dehdari and Hajimehdipoor, 2018, Rastogi et al. 2018, Vadi et al. 2017). A tea decoction, infusion and syrup of *A. capillus-veneris* is utilized in the management of coughs, throat troubles, bronchitis, too much mucous, lung troubles, respiratory disorders to sooth membranes and enlarge perspiration (Ahmed et al. 2012, Srivastava, 2007). Furthermore Chopra et al. (1986), suggested that a tea or syrup is used in the treatment of coughs, throat afflictions and bronchitis. A decoction of the entire plant is combined with milk and drunk as an anti-icteric. Superficially, it is rubbed to avoid hair loss (De Feo, 1992); this hair-stimulant result has also been observed in the Venezia Giullia region of Italy (Lokar and Poldini, 1988). The Mexican Kickapoo Indians utilize a decoction of the complete plant for its claimed antifertility consequence, for which it is mixed with *Dryopteris normalis* (Polypodiaceae) and drunk for four successive sunrise. It is useful with female situations and is utilize to normalize menstruation, dysmenorrhoea, and assisting childbirth by rapidity up the labor. It seems most helpful for young women and those having difficulty getting back on cycle subsequent to birthing, nursing, or coming off birth control pills (Murthy et al.1984, Murti, 1981). However in Iran, a decoction prepared from leaves is utilized as an expectorant and diaphoretic in the frequent cold, chronic or acute catarrh and bronchitis (Zargari, 1978). Moreover for whooping cough in children, a decoction of the root bark (50 ml) is given. Ash of the entire plant is given with honey for chronic cough and asthma (Khare, 2015).

Pharmacological Activities

1) Antibacterial activities

With disc diffusion technique, the antibacterial activity of Maidenhair fern against multidrug resistant (MDR) bacteria strains was accounted. The methanol extract of the plant leaves exhibited highest zone of inhibition against several bacteria such as *Providencia, K. pneumoniae, Shigella, V. cholera, S. aureus, P. vulgaris* and *S. typhi*. However stem methanol extract was extremely effective against *E. coli, K. pneumonia* and *S. typhi*. Aqueous leave fraction of the species was much potent against entire bacterial strains but its stem aqueous extract revealed minimum ZI against *E. coli, K. pneumonia, S. typhi, Shigella, P. vulgaris* and *Providencia* (Hussain et al. 2014). Moreover, the antibacterial activities of *A. capillus-veneris* methanolic extract against *S. aureus*, *E. coli*, and *H. pylori* has been confirmed (Shirazi et al. 2011). Additionally antibacterial consequence of gametophytic part of the plant was more significant than sporophyte, while assessed with crude and phenolic extracts of plant. Gram-positive species like *B. subtilis* exhibited more susceptibility to both extracts (Guha et al. 2004). Also the ethanolic fraction of Maidenhair fern aerial components have no antimicrobial competence against three pathogen bacteria such as *E. coli, S. aureus* and *P. aeruginosa* (Besharat et al. 2009).

2) Antifungal Activity

The extracted phenols and water extracts from different parts of sporophytes and gametophytes of *A. capillus-veneris* L. was reported for its antifungal action and found to be bioactive against *Aspergillus niger* and *Rhizopus stolonifer*. The activity was found to be superior in gametophytes. Between the diverse divisions of sporophytes, immature pinnule possesses premier fungi static property (Piyali et al. 2005).

3) Antioxidant activity

The ultrasonic-supported flavonoid fraction of the plant has been accounted for antioxidant competence. *In vitro* examinations were made through DPPH, scavenging competence of superoxide anion, chelating potential of ferrous ion and reducing power trials. By using acute

mice liver injury, in vivo examination was done. More effective antioxidant activity displayed in the outcome of the plant species than synthetic antioxidants such as BHT, EDTA, and ascorbic acid. However it showed momentous decline in superoxide dis-mutase (SOD), catalase (CAT) and glutathione (GSH) levels and notable increase in malondial-dehyde (MDA) levels, with *in vivo* assessment (Jiang et al. 2011). Additionally ethanolic leaves extract of *A. capillus-veneris* has evaluated against hydrogen peroxide-stimulated oxidative harm in marginal blood lymphocytes. It was verified the hindered of lipid peroxidation and enlarged in the level of antioxidant enzymes counting SOD, CAT, Gpx and glutathione content (Kumar, 2009). Through DPPH assay, it was confirmed the antioxidant activity of the plant essential oil. The antioxidant property of the essential oil might because of phytoconstituents such as carvone, carvacrol, and thymol, as suggested by Khodaie et al.(2015). Moreover *A. capillus-veneris* and *M. punctatum* were compared, and accounted that the increase in malondialdehyde levels and antioxidant enzymes counting SOD and glutathione peroxidase in *M. punctatum* were more effective (Sinam et al. 2012).

4) Anti-diabetic activity

The aqueous and methanol extracts of entire plant of *A. capillus-veneris* Linn have been proved anti-daibetic activity against streptozotocin stimulated diabetes in rats. The investigation determined that methanol extract at high dose (400 mg/kg b.wt) and aqueous extract at low dose (100 mg/kg b.wt) has convenient outcomes on blood glucose level (Rajan et al. 2014). Another investigation displayed considerable increase in rat's body mass and amylase enzyme and decline in the blood glucose. The capability of the plant to achieve mass was because of its repair competence on hepato-renal damaged cell. Besides, enlarged in serum amylase was due to insulin-like components in the species which influence pancreas action for amylase discharge (Sultan et al. 2012). Besides, it was stated that the species exhibited antihyperglycemic property analogous to Acarbose as reference drug (Kasabri et al. 2017).

5) Anticancer activity

The report on both crude methanol extract and gold nanoparticles of *A. capillus veneris* (ACV) and *Pteris Quadriureta* (PQ) were trialed for their anticancer activities in MCF7 and BT47 cell lines. By using GC-MS, it identified 23 and 28 bioactive compounds in ACV and PQ respectively. The outcome of ACV and PQ nanoparticles on different proteins concerned in cell cycle and apoptosis using western blotting and PCR were examined and measured number of cells enduring apoptosis by flow cytometry. It observed anti-proliferative and apoptosis stimulating properties against cell lines with both the crude extract and nanoparticles. It showed phytol and eicosapentaenoic acid present in ACV and PQ, act together with Bcl2 and cyclin D1 with docking analysis. It verified that ACV and PQ that efficiently transform various oncogenic molecules can be used as capable mediator for cancer therapy (Rautray et al. 2018).

6) Anti inflammatory activity

The alcoholic extract of *A. capillus-veneris* and its hexane fraction displayed a considerable anti-inflammatory action against formalin stimulated inflammation. The hexane fraction and compounds 3, 4 exhibited topical anti-inflammatory activity subsequent to 6 h and persistent for 30 h in croton oil- activated inflammation (Ibrahim et al. 2011). Furthermore with ethyl acetate fraction of the ethanolic extract of *A. capillus-veneris* exhibited momentous inhibition of hind paw oedema stimulated by carrageenan, while assessed for its anti-inflammatory action (Haider et al. 2011).

7) Analgesic activity

The analgesic activity of the ethanolic extract of *A. capillus-veneris* and its fraction has been conducted by tail flick technique and writhing trial. The outcome displayed significant analgesic activity with insignificant ulceration as correlated to the standard medicine (Haider et al. 2011).

8) Antiobesity effect

The aerial parts aqueous extract of the herb showed phospholipase inhibitory consequence through an *in vitro* model, which was comparable to orlistat. The Chlorogenic acid was furthermore reported as the main phytoconstituent (Kasabri et al. 2017).

9) Anti-asthmatic activity

The anti-asthmatic consequence of the ethanolic extract from *A. capillus-veneris* leaves was confirmed through histamine aerosol-stimulated asthma in guinea pig. Animals treated with EEAC exhibited considerably expanded the latent phase of convulsions (PCT) as compared to control animals, while exposure of histamine aerosol. It should be prominent that the herb has been conventionally used as anti-asthmatic agent (Swaroop et al. 2012).

10) Antidepressant Activity

In the investigation, white male rats weighing 250-300 g were assigned to 5 groups of 10 each chronic unpredictable stress (CUS) was activated by 3-week introduction to chronic stress. The forced swim trial and plus maze were used to evaluate depression and anxiety, respectively. Treatment with *A. capillus-veneris* extract at 200 mg/kg significantly declined the period of immobility. A significant enlarged in the number of open arm entries were observed in the group treated with extract at 200 mg/kg, while compared to the control group. Extract at 50, 100, and 200 mg/kg resulted in a significant increase in the time spent in the open arm. It was condensed Malondialdehyde (MDA) levels and increased antioxidant levels of serum and brain in rat (Rabiei and Setorki, 2019).

11) Wound Healing activity

The aqueous fraction of *A. capillus-veneris* supported considerable angiogenesis through both capillary-like tubular creations and production of endothelial cells *in vitro*. Furthermore, in the trials for protection against harm to fibroblasts by oxygen free radicals, water and butanol fractions exhibited significant defensive outcomes in the concentrations 50, and 500 µg/ml in contrast with a control group. However in the toxicity examination, it displayed weak irritation in the Hen's egg experiment chorioallantoic membrane (CAM) bioassay at the vascular level on the CAM of the chicken. Additionally no significant cytotoxicity were observed in the MTT evaluation on usual human dermal fibroblasts (Nilforoushzadeh et al. 2014).

12) Lithotriptic activity

With crystallization, aggregation and nucleation assays, *in vitro* antilithiasic activity of hydro alcoholic extract of *A. capillus-veneris* was evaluated. The consequence exhibited considerable inhibition of crystallization and aggregation which was further established by *in vivo* investigation against ethylene glycol (0.75%) and ammonium chloride (1%), stimulated Urolithiasis in male Sprague Dawley rats. It further focused and displayed that significant drop in the number of crystals in trial groups with the practice of Urine microscopy (Ahmed, 2012).

13) Hypocholesterolemic effect

The hypocholesterolemic outcome from aqueous fraction of *A. capillus-veneris* was accounted by using high cholesterol diet (HCD) fed model in rats animal. The effective decline of whole cholesterol (TC), LDL and VLDL serum levels with no effect on HDL level were observed in conclusion. Moreover, athero-genic index of TC/HDL was roughly regularized in rats that treated with *A. capillus-veneris* (Chimie et al. 2015).

14) Antidiarrheal and antispasmodic activities

The crude extract of dried leaves of *A. capillus-veneris* displayed antidiarrheal consequence against castor oil-stimulated diarrhea in mice at 300 and 500 mg/kg, parallel to the outcome loperamide. In isolated rabbit jejunum, extract of *A. capillus-veneris* exhibited a concentration-dependent relaxation of spontaneous and low K^+ (25 mM)-induced contractions and had weak inhibitory consequence on high K^+ (80 mM), parallel to the activity model of cromakalim, an ATP-dependent K^+ channel opener. The facts revealed that plant possesses antidiarrheal and antispasmodic properties reconciled probably through ATP-dependent K^+ channels activation, hence offering systematic basis to its folk exercise in abdominal colic and diarrhea (Janbaz et al. 2015)**.**

15) Urinary tract effect

On urinary tract, the usefulness of water extract of *A. capillus-veneris* was reported. The consequence exerted inhibition outcome on entire trialed bacterial species. Systemic *Candida albicans* infection model was utilized in mice to examine the protective action of the plant. Also along with superior renal pathological characteristics, it was declined colony-forming units (CFU) of *C. albicans* in the spleen. Further, it exhibited dual consequences on diuresis action. The low and high dosage usually raised and reduced significantly urinary output respectively. With this results, the report suggested that the plant species can be used for management of urinary tract infection (UTI) (Yuan et al. 2010). It was further reported by Ahmed et al. (2013a) for anti-calcium oxalate urolithiasic property in male rats using hydroalcoholic extract of *A. capillus-veneris*. The outcome exposed significant declined in the number of crystals and dropping in the serum level of calcium, phosphorous and blood urea. The document further established the outcome through an *in vitro* investigation. The plant restrained the crystallization, crystal aggregation, and also declined in the amount and the volumes of crystals (Ahmed et al. 2013b).

16) Hypoglycemic activity

It declined glucose-stimulated hyperglycemia, while whole extract of the plant prepared by boiling the dried material with water and was given to mice (25 mg/kg) orally. However it does not exhibited hypoglycemic activity, when the extract of the plant prepared by maceration with 80% ethanol and given to mice (25 mg/kg) orally (Neef et al. 1995). Additionally the alcoholic extract of *A. capillus-veneris* displayed significant hypoglycaemic outcome in rabbit model, started once 30 min of administration of the extract and sustained for 4 hrs. (Ibrahim et al. 2011b).

17) Anti-Nociceptive Activity

Both anti-inflammatory and antinociceptive activity of the ethanolic extract of dried leaves of *A. capillus* (ACEE), using the Carrageenan-induced paw edema technique in rats and Tail-flick technique in mice, respectively, at various dose levels were investigated. The extract confirmed noticeable antinociceptive activity at a dose of 300 mg/kg, and the outcome was comparable to that of standard drug, Ibuprofen (100 mg/kg orally) ($p<0.05$) (Gupta et al. 2010).

18) Antithyroidal effect

The report from Tirumala, AP, India exposed on the influence of *A. capillus-veneris* on the thyroid dysfunction-hypothyroidism in terms of resolving thyroid gland weight, thyroid peroxidase activity, iodine in urine, total thyroxine (T4), triiodothyronine (T3) and TSH in serum. The mass of thyroid gland was declined, while thyroid peroxidase action, serum T4 and serum T3 levels were enlarged in rat, treated with the ethanol extract; however serum TSH level reduced extensively while compared with hypothyroid control male rats. The outcome of lipid peroxidation and antioxidant enzyme assay designated that malondialdehyde was significantly declined and antioxidant enzymes were amplified, while treated with ethanol extract. With the outlined

consequences, plant could be used for the normalization of hypothyroidism (Vijayalakshmia and Kumarb, 2013).

19) Cytotoxic Activities

The methanolic extract of aerial pieces of *A. capillus-veneris* L. and it's different solvent fractions were documented for antioxidant and cytotoxic activities. It recorded premier DPPH radicals scavenging property of ethyl acetate soluble fraction, as compared to positive control ascorbic acid. Additionally *ex vivo* cytotoxicity assay of plant extract and its different fractions were conducted against HELA cells line. The consequence confirmed that ethyl acetate and n-hexane soluble fractions exhibited outstanding cytotoxicity with IC50 value of 5.68 µg/ml and 17.15 µg/ml, respectively. The report declared that superior antioxidant and cytotoxic activities were shown by ethyl acetate soluble fraction of methanolic extract of aerial parts of plant growing in Bangladesh which specifies the incidence of bioactive phytoconstituents in the extractives (Roy et al. 2019).

20) Neuropharmacological activities

The plant revealed significant anticon-vulsant consequence through prolonging the onset of action and reduction in the period of seizures in PTZ-induced convulsion model, in addition by decrease in the time of different phases of seizure through MES-induced seizure method. In mice forced swim assay, the species exhibited depressant property by prolonging the immobility time. The species was not demonstrated notable skeletal muscle relaxation as well. From results it revealed that the ethanolic plant extract possess significant neuropharmacological properties. However extract at dose 400 mg/kg body weight was found to be more effective (Jain et al. 2014).

CONCLUSION

The medicines obtained from plant resources are extensively used in the treatment of different human diseases. The source of phytochemical constituents in plants are leaves, roots, barks, stems, seeds and reproductive cones. The phytochemicals are employed in the preparation of homeopathic, allopathic, and Ayurvedic medicines. The sophisticated expertise has contributed a lot in the preparation of broad variety of medicines. This plant can be used as a natural potent and secure mediator to alleviate several medical symptoms and illness due to its valuable pharmacological properties. The maidenhair fern frond can be a good candidate for experimental purpose. However, in spite of diverse in vitro and in vivo investigations, lack of wide-ranging clinical examinations focused on considered activities, and are remaining to ascertain the conventional records. Further phytochemical and biological investigations should be carried out on this genus in order to reveal their active principles and mechanisms of action of the active components. Thus, further researches are desirable in order to compile the clinical outcomes of this plant via human studies. Apart from the medicinal utility, the trees are collected for a variety of functions, therefore protection status of these plant species are in alarming rate.

LITERATURE CITED

1. Abbas M, Ismail AM, and Al-Majmaie S. 2023. Anatomical Study of Common Maidenhair Fern (*Adiantum capillus-veneris* L) Pteridaceae, in Iraq. Al-Nahrain Journal of Science, 26(2): 60-63. doi:10.22401/ANJS.26.2.10
2. Abbasi AM, Khan MA, Ahmad M, Zafar M, Jahan S and Sultan S. 2010. Ethnopharmacological application of medicinal plants to cure skin diseases and in folk cosmetics among the tribal communities of North-West Frontier Province. Pakistan Journal of Ethnopharmacology, 128: 322-335. doi:10.1016/j.jep.2010.01.052.
3. Abbasi M, Khan MA, Ahmad M, Zafar M, Khan H, Muhammad N and Sultana S. 2009. Medicinal plants used for the treatment of jaundice and hepatitis based on socio-economic documentation. African Journal of Biotechnology, 8: 1643-1650.
4. Ahmad I, Hussain M, Ahmad MSA, Ashraf MY, Ahmad R and Ali A. 2008. Spatio-temporal variations in physiochemical attributes of *Adiantum capillus-veneris* from Soone valley of salt range (Pakistan). Pakistan Journal of Botany, 40: 1387-1398.
5. Ahmed A, Bilal A, Hajera S, Jahan N, and Wadud A. 2013b. In vitro effect of hydro alcoholic extract of *Adiantum capillus-veneris* Linn. on calcium oxalate crystallization. International Journal of Green Pharmacy, 7(2): 106-110. doi.org/10.22377/ijgp.v7i2.305
6. Ahmed A, Jahan N, Wadud A, Imam H, Hajera S, and Bilal A. 2012. Physicochemical and biological properties of *Adiantum capillus-veneris* Linn: An important drug of Unani system of medicine. International Journal of Current Research Review, 4(21): 70-75.
7. Ahmed A, Wadud A, Jahan N et al. 2013a. Efficacy of *Adiantum capillus veneris* Linn in chemically induced urolithiasis in rats. Journal of Ethnopharmacology, 146(1): 411-416.
8. Ahmed SA. 2012. Antilithiasic activity of Parsiaoshan in experimental models (dissertation). National Institute of Unani Medicine: RGUHS, Bangalore.
9. AL-Khesraji TO, Ismail AM and Maulood BK. 2017. Flavonoid Contents of *Adiantum capillus-veneris* L. Growing in Two Different Districts from Iraqi Kurdistan Northern Iraq. Egyptian Academic Journal of Biological Sciences H Botany, 8(1): 25-31. doi:10.21608/eajbsh.2017.16815
10. Al-Qura'n S. 2009. Ethnopharmacological survey of wild medicinal plants in Showbak. Jordan Journal of Ethnopharmacology, 123: 45-50.
11. Anonymous, 2003. The wealth of India. Volume- I: A. New Delhi: National Institute of Science Communication and Information Resources (CSIR); 79-80.

12. Besharat M, Rahimian M, Ghaemi E, and Besharat S. 2009. Effect of ethanolic extract of *Adiantum capillus-veneris* in comparison with Gentamicine on 3 pathogenic bacteria in vitro. Pharmaceutical Science, 15(1): 49-52.
13. Boukada F, Sara S, Hafida K, Boumediene M, and Fatima ZS. 2022. Chemical composition, antioxidant and antibacterial activity of *Adiantum capillus-veneris* L. extract from Algeria. Kragujevac Journal of Science, 44: 91-101. doi:10.5937/KgJSci2244091B
14. Camejo-Rodrigues J, Ascensão L, Bonet MÀ, and Vallès J. 2003. An ethnobotanical study of medicinal and aromatic plants in the Natural Park of Serra de São Mamede (Portugal). Journal of Ethnopharmacology, 89: 199-209.
15. Chang HC, Gupta SK, and Tsay HS. 2011. Studies on folk medicinal fern: An example of "Gu-Sui-Bu". Working with ferns (285-304). New York: Springer.
16. Chatterjee A and Pakrashi SC. 2005. The treatise on Indian medicinal plants. Vol 1. New Delhi: National Institute of Science Communication and Information Resources (CSIR); 8.
17. Chimie RRD, Al-hallaq EK, Litescu SC et al. 2015. Hypocholesterolemic Effects of *Adiantum capillus Veneris* L. aqueous extract in high Cholesterol diet-fed rats and hplc-ms determination of its polyphenolics. Academia Română Revue Roumaine de Chimie, 60(4): 357-365.
18. Chopra RN, Nayar SL, and Chopra IC. 1986. Glossary of Indian Medicinal Plants, CSIR, New Delhi.
19. Dastagir G. 2001. Medicinal plants of Mai Dhani hill Muzaffarabad (AJK), Pakistan. Hamdard Med., 44: 29-35.
20. De Feo V. 1992. Medicinal and Magical Plants in the Northern Peruvian Andes. Fitoterapia, 63: 417-440.
21. De Natale A and Pollio A. 2007. Plants species in the folk Medicine of Montecorvino Rovella (inland Campania, Italy). Journal of Ethnopharmacology, 109: 295-303.
22. Dehdari S, and Hajimehdipoor H. 2018. Medicinal Properties of *Adiantum Capillus-Veneris* Linn. in Traditional Medicine and Modern Phytotherapy: A Review Article. Iranian Journal of Public Health, 47(2): 188-197.
23. Gruenwald J, Brendler T, and Jaenicke C. 2008. PDR for herbal medicines. Montvale: Medical Economics Company, 491-492.
24. Guarrera PM, Lucchese F and Medori S. 2008. Ethnophyto therapeutical Research in the high Molise region (Central-Southern Italy). Journal of Ethnobiology and Ethnomedicine 4: 7. doi:10.1186/1746-4269-4-7.
25. Guha P, Mukhopadhyay R, Pal PK, and Gupta K. 2004. Antimicrobial activity of crude extracts and extracted phenols from gametophyte and sporophytic plant parts of *Adiantum capillus-veneris* L. Allelopathy Journal, 13(1): 57-66.
26. Gupta V, Bansal P, Kumar P and Kaur G. 2010. Anti-Inflammatory and Anti-Nociceptive Activity of *Adiantum capillus.* Research Journal of Pharmacy and Technology, 3(2): 432-434.
27. Haider S, Kharbanda C, Alam MS, Hamid H, Ali M, Alam M, Nazreen S, and Ali Y. 2013. Anti inflammatory and anti-nociceptive activities of two new triterpenoids from *Adiantum capillus-veneris* Linn. Natural Product Research, 27: 2304-2310. doi:10.1080/14786419.2013.828292
28. Haider S, Nazreen S, Alam MM, Gupta A, Hamid H, and Alam MS. 2011. Anti-inflammatory and anti-nociceptive activities of hdroalcoholicextract and its various fractions from *Adiantum capillus veneris* Linn. Journal of Ethnopharmacology, 138(3): 741-747.doi:10.1016/j.jep.2011.10.012
29. Hamayun M, Khan SA, Sohn EY and Lee IJ. 2006. Folk medicinal knowledge and conservation status of some economically valued medicinal plants of district Swat, Pakistan. Lyonia, 11: 101-113.
30. Ho R, Teai T, Bianchini JP, Lafont R, and Raharivelomanana P. 2011. Ferns: From traditional uses to pharmaceutical development, chemical identification of active principles. In Working with ferns Eds Kumar, A., Fern´andez, H. & Revilla, M. Publishers: Springer, New York, 321-346.
31. Hoang LS, and Tran HPT. 2014. In *vitro* antioxidant and anticancer properties of active compounds from methanolic extract of *Pteris multifida* Poir leaves. European Journal of Medicinal Plants, 4(3): 292-302.
32. Hussain MM, Ahmad B, Rashid E et al. 2014. In vitro antibacterial activity of methanol and water extracts of *Adiantum capillus veneris* and *Tagetes patula* against multidrug resistant bacterial strains. Pakistan Journal of Botany, 46(1): 363-368.
33. Ibraheim ZZ, Ahmed AS, and Gouda YG. 2011. Phytochemical and biological studies of *Adiantum capillus-veneris* L. Saudi Pharmaceutical Journal, 19(2): 65-74. doi:10.1016/j.jsps.2011.01.007
34. Ibrahim ZZ, Ahmed AS, and Gouda YG. 2011b. Phytochemical and biological studies of *Adiantum capillus-veneris* L. Saudi Pharmaceutical Journal, 19(2): 65-74. doi:10.1016/j.jsps.2011.01.007
35. Ishaq MS, Hussain MM, Afridi MS, Ali G, Khattak M, Ahmad S, and Shakirullah. 2014. *In vitro* phytochemical, antibacterial, and antifungal activities of leaf, stem, and root extracts of *Adiantum capillus veneris*. Scientific World Journal, 269793. doi:10.1155/2014/269793.
36. Jain N, Magan A and Sondhi SM. 1992. Determination of mineral elements present in medicinal plants used for development of health, for treatment of cough and vomitting, pyorrhoea and rheumatic and allied disorder. Indian Drugs, 30: 190- 194.
37. Janbaz KH, Hassan W, Mehmood MH and Gilani AH. 2015. Antidiarrheal and antispasmodic activities of *Adiantum capillus veneris* are predominantly mediated through ATP-dependent K^+

channels activation. Bangladesh Journal of Pharmacology, 10(1): 222-229. doi:10.3329/bjp.v10i1.21869
38. Jain SK, Singh T, Pande M and Nema N. 2014. Neuropharmacological screening of fronds of *Adiantum capillus veneris* Linn. Der Pharmacia Letter, 6(3):167-175.
39. Jiang M-Z, Yan H, Wen Y, and Li X-m. 2011. In vitro and in vivo studies of antioxidant activities of flavonoids from *Adiantum capillus-veneris* L. African Journal of Pharmacy and Pharmacology, 5(18): 2079-2085. doi: 10.5897/AJPP11.500
40. Kalpana DR, Rajesh NV, Vasantha S, and Sathia Geetha V. 2015. Anti-parasitic action of *Actinopteris radiata*, *Acrostichum aureum* and *Hemionitis arifolia*. Pteridological Research, 4(1): 1-9.
41. Kasabri V, Al-Hallaq E, Bustanji Y et al. 2017. Antiobesity and antihyperglycaemic effects of *Adiantum capillus-veneris* extracts: in vitro and in vivo evaluations. Pharmaceutical Biology 55(1): 164-172. doi:10.1080/13880209.2016.1233567
42. Khare CP. 2015. Ayurvedic pharmacopoeial plant drug. Florida: CRC Press, 26.
43. Khodaie L, Esnaashari S, and Moghaddam SB. 2015. Essential Oil of Arial Parts of *Adiantum capillus-veneris*: Chemical Composition and Antioxidant Activity. Jundishapur Natural Pharmacy Product, 10(4): 3-7. doi:10.17795/jjnpp-21968
44. Kumar A. 2009. Antioxidant Effect of *Adiantum capillus veneris* Linn. on human lymphocyte: An in vitro study. Journal of Cell Tissue Research, 9: 1899-1902.
45. Kumar M, Ramesh M, and Sequiera S. 2003. Medicinal Pteridophytes of Kerala, South India. Indian Fern Journal, 20: 1-28.
46. Kumar SS, Samydurai P, Ramakrishnan R, and Nagarajan N. 2014. Gas chromatography and mass spectrometry analysis of bioactive constituents of *Adiantum capillus-veneris* L. International Journal of Pharmacy and Pharmaceutical Sciences, 6(4): 60-63.
47. LH. 2011. Evaluation of Antibacterial, Antioxidant and Toxicological Activity of Crude Extracts of *Adiantum capillus-veneris*, *Blumea lacera*, *Cassia alata*, and *Cissus quadrangularis*. BRAC, Dept of Mathematics and Natural Sciences. http://hdl.handle.net/10361/1497
48. Lokar LC, and Poldini L. 1988. Herbal remedies in the traditional medicine of the Venezia Giulia region (north east Italy). Journal of Ethnopharmacology, 22(3): 231-279. doi:10.1016/0378-8741(88)90238-3.
49. Marino A, Elberti MG, and Cataldo. 1989. Phytochemical investigation of *Adiantum capillus veneris*. Boll Soc Ital Biol Sper, 65(5): 461-463.
50. McGaw LJ, Lall N, Meyer JJM, and Eloff JN. 2008. The potential of South African plants against *Mycobacterium* infections. Journal of Ethnopharmacology, 119: 482-500.
51. Murthy RSR, Basu DK, and Murti VVS. 1984. Anti-implantation activity *of* isoadiantone. Indian Drugs, 21: 141-144.
52. Murti S. 1981. Post Coital Anti-implantation Activity of Indian Medicinal Plants. Abstract 32nd Indian Pharmaceutical Cong. Nagpur, 14: 23-35.
53. Nakane T, Maeda Y, Ebihara H, Arai Y, Masuda K, Takano A, Ageta H, Shiojima K, Cai SQ, and Abdel-Halim OB. 2002. Fern constituents: Triterpenoids *from Adiantum capillus veneris*. Chemical Pharma Bulletin, 50: 1273-1275. doi: 10.1248/cpb.50.1273.
54. Neef H, Declercq HN, and Laekman G. 1995. Hypoglycaemic activity of selected European plants. Phytotherapy Research, 9(1): 45-48.
55. Nilforoushzadeh MA, Haghjooy JS, Ghanadian M, Asghari G, Jaffary F, Fallah YA, Dana N, and Fatemi SA. 2014. The Effects of *Adiantum capillus-veneris* on Wound Healing: An Experimental *In Vitro* Evaluation. International Journal of Preventive Medicines, 5: 1261-1268. doi: 10.4103/ijpvm.ijpvm_126_24.
56. Piyali G, Mukhopadhyay R, and Gupta K. 2005. Antifungal activity of the extracts and extracted phenols from gametophytes and sporophytes of two species of *Adiantum*. Taiwania 50(4): 272-283. doi:10.6165/tai.2005.50(4).272
57. Puri GS, and Arora RK. 1961. Some medicinal ferns from Western India. Indian Forester, 87: 179-183.
58. Qadir SA, Awlqadr FH, Qadir MH, Qadir AM, Mahmood AF, Salih SA, Mohammed NS, Khaled A, and Seyed MNH. 2025. *Adiantum capillus-veneris*: A Comprehensive Review of Its Medicinal Properties, Bioactive compounds, and advanced extraction Techniques. Food Science and Nutrition, 1-20. doi:10.1002/fsn3.71118
59. Rabiei Zahra, and Setorki Mahbubeh. 2019. Effect of ethanol *Adiantum capillus-veneris* extract in experimental models of anxiety and depression. Brazilian Journal of Pharmaceutical Sciences, 55. doi:10.1590/s2175-97902019000118099
60. Vadi R, Vats M, Gupta N and Sardana S. 2014. Antidiabetic Potential of Whole Plant of *Adiantum capillus veneris* Linn. in Streptozotocin Induced Diabetic Rats. International Journal of Pharmaceutical and Clinical Research, 6(4): 341-347. 2014; 6(4): 341-347
61. Rastogi S, Pandey MM, and Rawat AKS. 2018. Ethnopharmacological Uses, Phytochemistry and Pharmacology of Genus *Adiantum*: A Comprehensive Review. Journal of Ethnopharmacology, 215: 101-119.
62. Rautray S, Panikar S, Amutha T, Rajananthini AU. 2018. Anticancer activity of *Adiantum capillus veneris* and *Pteris quadriureta* L. in human breast cancer cell lines. Molecular Biology Reporter, 45(6): 1897-1911. doi:10.1007/s11033-018-4337-y.
63. Reinaldo RCPS, Santiago ACP, Medeiros PM, and Albuquerque UP. 2015. Do ferns and lycophytes function as medicinal plants? A study of their low

representation in traditional pharmacopoeias. Journal of Ethnopharmacology, 175: 39-47.
64. Rout SD, Panda T, and Mishra N. 2009. Ethnomedicinal studies on some Pteridophytes of Similipal Biosphere Reserve, Orissa, India. International Journal of Medicine and Medical Sciences, 1(5): 192-197. doi:10.5897/IJMMS.9000099
65. Roy SC, Sajeeb BK, Muhit MA, and Bachar SC. 2019. Evaluation of Antioxidant and Cytotoxic Activities of Aerial Parts of *Adiantum capillus-veneris* L. Growing in Bangladesh. Dhaka University Journal of Pharmaceutical Sciences, 18(2): 217-222. doi:10.3329/dujps.v18i2.43264
66. Santhoshkumar S, and Nagarajan N. 2012. Screening of Preliminary phytochemical constitution and antimicrobial activity of *Adiantum capillus-veneris*. Journal of Research in Antimicrobial., 1(1): 56-61.
67. Shinozaki J, Shibuya M, Masuda K, and Ebizuka Y. 2008. Squalene cyclase and oxidosqualene cyclase from a fern. FEBS Letter, 582: 310-318. doi: 10.1016/j.febslet.2007.12.023.
68. Shirazi MH, Amin G, Lavasani BA, and Eshraghi SS. 2011. Study of antibacterial properties of *Adiantum capillus-veneris* extract on eight species of gram positive and negative bacteria. Journal of Medicinal Plants, 10(40): 124-132.
69. Shirazi MH, Amin Gh, Akhondy LB, and Eshraghi SS. 2010. Study of the inhibitory effect of *Adiantum capillus-veneris* extract on gram-positive and gram negative bacteria. Medicinal Plant Journal, 4(40): 124-132.
70. Sinam G, Behera SK, Mishra RK et al. 2012. Comparison of two ferns (*Adiantum capillus-veneris* Linn. and *Microsorium punctatum* (Linn.) Copel) for their Cr accumulation potential and antioxidant responses. International Journal of Phytoremediation, 14(7): 629-642. doi:10.1080/15226514.2011.619229.
71. Singh C, Chauhan N, Upadhyay SK, and Singh R. 2020. Phytochemistry and Ethnopharmacological study of *Adiantum capillus-veneris* L. (Maidenhair fern). Plant Archives, 20(2): 3391-3398.
72. Singh KK, Saha S, and Maheshwari JK. 1989. Ethnomedicinal uses of some ferns among the tribals of Uttar Pradesh. Indian Fern Journal, 6: 63-67.
73. Singh M, Singh N, Khare PB, and Rawat AKS. 2008. Antimicrobial activity of some important *Adiantum* species used traditionally in indigenous systems of medicine. Journal of Ethnopharmacology, 115: 327-329.
74. Sood S, and Sharm N. 2010. Insect Growth Regulatory Activity of *Adiantum capillus-veneris* Against *Plutella xylostella* and *Aphis Craccivora* in Ethanol and Methanol. Research Journal of Agriculture and Biological Sciences, 6: 785-790.
75. Srivastava K. 2007. Ethnobotanical studies of some important ferns. Ethnobotanical Leaflets, 11: 164-172.
76. Sultan AH, Dizaye KF, and Hiwa BB. 2012. Histological, Immunocytochemical and Biochemical study of the effect of *Adiantum capillus* on Alloxan Induced Diabetic Rats. Middle East Journal of Internal Medicine, 5: 3-12.
77. Sureshkumar J, Silambarasan R, Bharati KA, Krupa J, Amalraj S, and Ayyanar M. 2018. A review on ethnomedicinally important Pteridophytes of India. Journal of Ethnopharmacology, 219: 269-287.
78. Swaroop KK, Anbu J, Anjana A et al. 2012. Influence of ethanolic leaf extract of *Sargassum wightii* and *Adiantum capillus* onhistamine induced asthma in animal model. International Journal of Pharmacy and Pharmaceutical Sciences, 4: 121-123.
79. The Plant List [database on the Internet], 2013. http://www.theplantlist.org/
80. Taylor L ND. 2009. The Healing Power of Rainforest Herbs: A Guide to Understanding and Using Herbal Medicinals (tropical plant database). Available at http://rain-tree.com/avenca.htm.
81. Vadi R, Manisha V, and Swati K. 2017. Hansraj (*Adiantum Capillus Veneris* Linn.): A Systematic Review on Its Ethnobotany, Phytochemical and Pharmacological Profile. International Journal of Ayurveda and Pharma Research. 5: 5-21.
82. Vijayalakshmia A, and Kumar YK**.** 2013. Evaluation of goitrogenic and antithyroidal effect of the fern *Adiantum capillus-veneris*. Revista Brasileira de Farmacognosia Brazilian Journal of Pharmacognosy, 23: 802-810.
83. Yuan QY, Ruan JL, and Cai YL. 2010. Effect of water extracts of *Adiantum capillus-veneris* L. on urinary tract infections. Chinese Pharmaceutical Journal, 45(18): 1389-1392.
84. Zangara A. 2003. The psychopharmacology of huperzine A: An alkaloid with cognitive enhancing and neuroprotective properties of interest in the treatment of Alzheimer's disease. Pharmacology, Biochemistry and Behavior, 75: 675-686.
85. Zargari A. 1978. Medicinal plants, (in Persian), (Tehran University Press Publications), 223-228.
86. Zou Z, Xu P, Wu C, Zhu W, Zhu G, He X, Zhang G, Hu J, Liu S, Zeng W, and Xu K. 2016. Carboxymethyl flavonoids and a chromone with antimicrobial activity from *Selaginella moellendorffii* Hieron. Fitoterapia, 111: 124-129. doi:10.1016/j.fitote2016.04.022