Traditional Uses and Pharmacological Effects of *Anagallis arvensis*: A Review

Zarmeena Yasmeen¹, Abdul Basit¹ and Sidra Tahir²

**Significance:**

*Anagallis arvensis* has recognized medicinal values as an anti-mycotic, antimicrobial, molluscicidal, antioxidant, anti-inflammatory, anti-leishmaniasis, anti-tumor, and spermatogenic. The present review highlights traditional uses, phytoconstituents and pharmacological effects of *Anagallis arvensis*.

**ABSTRACT**

*Anagallis arvensis* belongs to family primulaceae. It is a summer annual herb distributed worldwide or with a global spread abundantly found in Egypt, Palestine, a non-tropical region of South America, Taiwan, and India (more specifically Jammu & Kashmir). Different parts of plant contain variety of active constituents; such as glycosides, saponin, flavonoid, anthraquinone, alkaloids, rutin, kaempferol, oleananetrerpenes, anagalligenin, anagalligenone, stigasterol, arvenin I, arvenin II, curcubitacin B, D, E, I,L& Q, n-hexosamine, β-amyrin, sterols carbohydrates, lacceric acid. *Anagallis arvensis* has recognized medicinal values as an anti-mycotic, antimicrobial, molluscicidal, antioxidant, anti-inflammatory, anti-leishmaniasis, antiviral, cytotoxic, and spermatogenesis. The present review will highlight the traditional uses, phytoconstituents and pharmacological effects of *Anagallis arvensis*.

**Introduction**

In the traditional system of medications, plants have played a vital role in the cure or prevention of different diseases. Treatments were not only limited to humans but also to animals. (1) *Anagallis arvensis* is a summer annual herb which blossoms at the end of spring. (2) It has ability to modify according to climate. (3) It is found across the Europe and dispersed worldwide because of ruderal habitat. It is abundant in Egypt, Palestine, non-tropical region of South America, and Taiwan. (4-5) The literature witnesses 1000 species of the plant grouped in 22 genera which are further divided in 5 different tribes: Primuleae, Cyclamineae, Lysimachieae, Samoleaeae, and Corideae. *Anagallis* belongs to the Lysimachieae tribe comprising of 28 species. (6) This genus is characterized by some distinguishing characters, such as flowering pattern is pentamers, nectarless, polypetalous, and have a compound ovary. Petals of this genus have nyctinastic behavior, (i.e., open up in daylight but close at dusk), which leads to self-pollination. Pattern of pedicels shows the fertilized as well as unfertilized or un-pollinated flowers. This is quite an important feature as curvature in pedicels depicts a fertilized or pollinated flower, while a uniform pedicel indicates and unfertilized or unpollinated flower. (7) Various studies have shown the medicinal value of the plant, such as an expectorant, anti-bacterial, anti-diuretic, antioxidant, antimicrobial, antiviral, antifungal, mutagenic, antimutagenic, cytotoxic, anticancer, anti-leishmaniasis, liver cirrhosis, lung problems, gallstones, kidney stones, urinary infection, and dermatological activities. (8,9) Bronchicum, Sinupret, Pectosol, and Tussipect are its herbal compounds derived from roots and flowers of plants of family primulaceae. (10) *A. arvensis* contains many active constituents for instance; curcurbitac (a glycoside) and triterpenoid series of saponins are separated from the root of the plant. Similarly, kaempferol, rutin, quercetine, spinasterol (glucose), sterol, β-sitosterol, and stigasterol are found in flowers of the plant. Leaves are rich inoleananaerpenes, triterpene saponins, deglucoanagallosides, analagossides A, deglucoanagallosides B, different types of fatty acids e.g., stearic acids, linoleic acids, palpitic acids, oleic acid, anagallosides A, anagallosides B, and anagallosides C. In addition to this, aerial parts of *A. arvensis* also have many constituents, in particular, arvenin I, arvenin II, curcurbitacins B, curcurbitacins D, curcurbitacins E, β-amyrin, β-hexacosane, rutin, anagalligenin, anagalligenone, stigasterol, β-sitosterol, laccericacid, enzyme, and carbohydrates. (10-13) Colored species of *Anagallis arvensis* contains pelargonidin, delphinidin, 3- and 3,5-glycosides of malvidin, malvidin 3- glucosides, flavonol which are discovered by Wiering and de Vlaming (14). Two glucosidic saponins are present in *Anagallis arvensis*. (15-16) Aqueous extract of *Anagallis arvensis* contains arvenin, tannins, triterpenoids, saponins, and flavonoids.(17) Flavones, saponins and oleananetrerpenes are found in chloroform extract of the plant.(18) Quercetin 3-glucuronide and kaempferol 3 glucuronide are flavonoid constituents which are found in abundance in ethanolic extract of *Anagallis arvensis*, however, a little quantity of some other flavonoid constituents are also present, namely, quercetin 3,7-diglucosid, quercetin 7-glucoside, kaempferol 7-glucoside. Kaempferol 3,7-diglucosid, isorhamnetin 3-glucoside, isorhamnetin 3-glucuronid and anthocyanins are malvidin 3-rhamnoside, malvidin 3-glucoside, and pelargonidin. (19) Furthermore, anthocyanins present in *Anagallis*
arvensis are malvidin 3-glucoside and pelargonidin. (15) Structural composition of antiviral saponin is (3-0-glucose (1→1→3 or 4)– [arabinose (1→1→ 4 or 3)]→glucose (1→2)-xyloside of 23-hydroxyprotoprimulagenin A). (20) Aqueous, aqueous ethanol, ethanol, chloroform and petroleum ether extracts of Anagallis contain functional proteins. However, chloroform extract contains flavonoids too. (21) Dihydrocucurbitacin B, cucurbitacin B, cucurbitacin D, cucurbitacin E, cucurbitacin I, cucurbitacin L and cucurbitacin Q are reported to be present in Anagallis. (22) Methanolic HCl extraction in petal cells of plant separates the flavonoids and crystalline anthocyanins which are malvidin 3-rhamnoside, malvidin, luteolin, luteolin 7-glucoside, quercetin 3-rhamnosid, and quercetin. (23).

Traditional Uses
The significance of traditional plants towards mindfulness of individuals and populations cannot be ignored. The compound substance in plants has therapeutic importance and they deliver a vivid physiological activity on the human body, medicinal plants play a vital role in curing illness, because of the presence of secondary metabolites. (14) In Taiwan, the whole herb of Anagallis arvensis is used for liver complications. (24) In Italy, Anagallis arvensis was used in veterinary practices for curing mastitis, because of its powerful anti-inflammatory and emollient properties. Interestingly, Anagallis arvensis was amongst 4 plants for treating conjunctivitis. (25) It was a popular use for skin diseases. The plant used topically for wound healing both in humans and animals. Different types of pharmaceutical dosage forms, including ointments and infusions, where having been applied to get both local and systemic benefits from the plant. The slurry of the leaf is used for removing the leeches from cattle’s nostrils. (26-28) In rural areas of Nepal, this plant is used as a piscicidal agent while the whole plant is used for the poisoning of fish, (29) Pelotaris of Bosque used ointments for healing wounds of hands after their matches. Seeds and herb used as sudorific and in rabies. (22) In India, whole plant of Anagallis arvensis L. is used as sedative, stimulant, antiinflammatory, and antiinfluenat in cattle. (30) In Navarra, poultice, decoction, ointment or infusion of whole or aerial parts of Anagallis arvensis is used as an anti-hemorrhagic and antiseptic. (31) Anagallis arvensis (Chari saben) is enlisted in of “Plants having Antitussive and Expectorant activity”. (32)

Pharmacological Effects
1. Antimycotic Activity
Dermatophytes are pathogens against keratinized structures of mammals, including humans (rarely, birds). Skin, hair, nails and subcutaneous tissues of the body are rich in keratin. (34) Dermatophytooses, communicable mycoses of the skin that is infected by dermatophytes. (34) Thesmain drawbacks of current synthetic antifungal agents are development of resistance, toxicity or mere fungistatic effects. There is need to search for a novel and natural antifungal agent which minimizes the earlier cited limitations. Medicinal plants and plant derivatives play a vital role in drug discovery and the development of a drug. (35) Anagallis arvensis was the most efficacious antimycotic agent amongst 22 tested plant extracts. Aqueous extract of Anagallis arvensis was investigated for antifungal activity against Trichophytonmentagrophytes (SH13, SH1, SH8), Trichophytonviolaceum (S5, SH32, SH38) and Microsporumcanis (S14, S20, and SH41), further maintained at 10°C on SDA slants. The serial agar dilution plate technique was employed to get the fungi toxic results. Minimum Inhibitory Concentration (MIC) of aqueous extract of A. arvensis measured were 25, 15, 16 mg/ml and Means of mycelial percentage inhibition were 78.2±7.30%, 100±40% and 94.2±5.90% against Trichophyton mentagrophytes, Trichophyton violaceum, Microsporum canis respectively. (17) Anagallis arvensis leaf extract prepared with sterile water showed fungi toxic potential on test specie i.e., Colletotrichum papaya. (16) Similarly, ethanolic extract of A. arvensis is potent for phytopathogenic fungus of particular genera including Ceratocystis, Cytospora, Fomes, and Pestaiotiopsis. (18) MIC of methanolic extract of A. arvensis is 0.31mg/ml which is the maximum inhibition against Candida albicans. (36)

2. Antimicrobial Activity
Methanolic extract of Anagallis arvensis was further evaluated for its antimicrobial properties. Antibacterial activity was determined by using standard streptomycin against four different bacteria which are Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa and Bacillus subtilis with their references ATCC 11775, ATCC 12600, ATCC 9027 and ATCC 6051 respectively. The whole protocol was performed in triplicates. The minimum inhibitory concentration of one fungus and four bacteria was calculated for all extracts individually. Growth of two bacteria E. coli and B. subtiliss was inhibited by the methanolic extract of A. arvensis. Saponins seem to have a role as antimicrobial constituent as they can cause damage to cells. (36)Significant activity was recorded for the ethanolic extract of Anagallis arvensis against P. Vulgaris which is a gram-negative bacillus.(37)

3. Molluscidal Activity
Anagallis arvensis is considered highly active as a molluscicidal agent for schistosomiasis. Schistosomiasis is a human infection that is caused by a trematode Schistosoma mansoni. This trematode
produces due to poor irrigation system. The molluscidal ability comes primarily from its allele chemicals. A demonstration was carried out in the department of parasitology lab, National Institute of Infectious Diseases, Tokyo, two intermediate species of young snails were taken, one was Oncomelaniaquadrasii and the other was Schistosoma mansoni. Ideal standard for molluscidal used Niclosamide, a synthetic compound was taken as a positive control. Molluscidal constituents’ saponins which were separated by chromatographic technique. Two compounds deglucoangalloside B and angalloside B were reported as molluscidal constituents from which deglucoangalloside was more active. (9, 38)

4. Antioxidant Activity
Aqueous extract of A. arvensis showed more prominent results. Non-linear regression method was used to calculate the free radical scavenging activity by comparing IC50 values. (36)

5. Anti-Inflammatory Activity
Anagallis arvensis has reported possessing anti-inflammatory activity. Indomethacin, an analgesic and anti-inflammatory drug was used as a standard against COX-1 and for COX-2 inhibition control was nimesulide which has selectivity against COX-2. Methanolic extract of A. arvensis showed cyclooxygenase inhibition at significant concentration and reduced the prostaglandin synthesis; however, the extract in aqueous form was only active at a concentration equal to 1mg/ml. However, indomethacin (5 µM) had the potential of minimizing the prostaglandin synthesis to the level of 42% and the same for nimesulide (200 µM) which had 47% capability of lowering the prostaglandin synthesis. Saponins and flavonoids are responsible constituents for the anti-inflammatory potential of AA. (36)

6. Antileishmania Activity
Anagallis arvensis, alcoholic extract of whole herb is effective for anti-leishmania activity (IC50 < 0.125 µg/mL, SI > 128). The assay was confirmed by using a reference of maesabalides, at the same point both reference and plant extract showed purple spot. (39)

7. Antiviral Activity
Antiviral activity of A. arvensis has been cited in favor of extract made with ethanol for poliovirus as well as for HSV type 1. Triterpenoid saponins (3-0- glucose (1→1→3 or 4-) [arabinose (1→1→4 or 3)]-glucose (1→2)-xyloside of 23-hydroxyprotoprimulagenin A) are reported to be efficacious at a minimum concentration of 4µg/ml against poliovirus and herpes simplex viruses when in vitro activity is performed. (20) Vero cells were observed for in-vitro antiviral studies. Saponins present in Anagallis arvensis are responsible for antiviral properties and have broad spectra against many viruses including HSV 1 polioviruses. These phytocomponents not only inhibit the cytopathogenesis in the host cell but also minimize the production of new viruses. Keratitis was induced in rabbits to study in vivo antiviral activity of isolated saponins from A. arvensis against three different standard antiviral ointments, as (3% ACV) acycloguanosine, (0.24% IUdR) 5-ido-2'-deoxyuridine and (3% Ara-A or 3% Vira-A) 9-1-a-arabinofuranosyladenine. Daily percentage of reduction in keratitis was measured. Dose of saponins greater than 7mg/g should not be applied as it may be toxic for eye treatment. The mean reduction in infection was given as the maximum reduction percentage of acycloguanosine(81.5%) had greater reduction percentage than that of Anagallis (7 mg/g) 44.8% and Anagallis (7mg/g) had more reduction percentage than adenine arabinoside as 38.9% which was further compared with a lower reduction percentage of idoxuridine i.e. 31.4% and finally the least reduction percentage was shown by Anagallis (5 mg/g) 25.7%. (41)

8. Cytotoxic Activity
Plant as a whole has been reported for its cytotoxic activity. Survival and cell death are estimated by MTT [3-(4, 5-Dimethylthiazol-2-yl)-2, 5-Diphenyltetrazolium Bromide] and LDH [lactate dehydrogenase] assays respectively, on cell cultures of two model cell lines DHD/K12PR and PC12, from a rat. In the presence of mitochondrial enzymes in viable cells, prognostic factor for cell survival was the change of color from yellow to a purple compound named Formazan in 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT). There was a noted inverse relation i.e., PC12 cell survival was decreased as the dose of methanolic and aqueous extracts were increased. Cells of DHD / K12PRob were responsive to the methanolic form of extracts only. Cell death was checked by replacing MTT with LDH in 96 well plates for both cells. The activity of LDH for the cells that remain untreated is measured to find out the LDH spontaneously released, the methanolic extract showed far better cytotoxicity against more sensitive PC12 cells as compared to those of DHD / K12PRob cells. (27)

9. Spermatogenic Effects
The plant is reported for semen coagulating and spermicidal activities. (42)

Conclusion
Anagallis arvensis has reputed medicinal uses as antimycotic, antimicrobial, molluscidic, antioxidant, anti-inflammatory, antileishmania, antiviral, cytotoxic and spermatogenesis.
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