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

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Significance:
Anagallis arvensis has recognized medicinal values as an anti-mycotic, antimicrobial, molluscicidal, antioxidant, anti-inflammatory, anti-leishmania, antiviral, cytotoxic, and spermatogenic. The present review highlights traditional uses, phytoconstituents and pharmacological effects of Anagallis arvensis.

ABSTRACT

Anagallis arvesnsis belongs to family primulacae. 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, oleananetriterpenes, anagalligenin, anagalligenone, stigasetrol, arvenin I, arvenin II, cucurbitacin 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-leishmania, 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, Samoleae, 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 pentamerous, 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 depictsa 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; cucurbitacin (a glycoside) and triterpenoid series of saponins are separated from the root of the plant. Similarly, kaempferol, rutin, quercitin, spinasterol (glucoside), sterol, ß-sitosterol, and stigasterol are found in flowers of the plant. Leaves are rich inoleananetriterpenes, 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, cucurbitacins B, cucurbitacins D, cucurbitacins E,ß-amyrin, n-hexacosane, rutin, anagalligenin, anagalligenone, stigasterol, ß-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 oleananetriterpenes 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) Ithas 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 and antiasthmatic, and antiflatulent 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 Anti-tussive 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) Dermatophytoses, communicable mycoses of the skin that is infected by dermatophytes. (34) Themain 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 10ºC 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±0% and 94.2±5.90% against *Trichophyton mentagrophytes, Trichophyton violaceum, Microsporumcanis* 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 subtillis* 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. subtillis* 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. Molluscicidal 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 molluscicidal 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 i.e* the intermediate host of *Schistosoma japonicum* and the other was *Biophalariaglabrata*, intermediate host of *Schistosoma mansoni.* Ideal standard for mulloscicide used Niclosamide, a synthetic compound was taken as a positive control. Molluscicidal constituents' *i.e* saponins which were separated by chromatographic technique. Two compounds deglucoanagalloside B and anagallosside B were reported as molluscicidal 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 IC_{50} 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 phytoconstituents not only inhibit the cytopathogenesis in the host cell but also minimize the production of new viruses. Keratitis was induced in rabbits to study invivo antiviral activity of isolated saponins from *A. arvensis* against three different standard antiviral ointments, as (3% ACV) acycloguanosine, (0.24% IUdR) 5-iodo-2'-deoxyuridine and (3% Ara-A or 3% Vira-A) 9-f-n-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. Spermatogenetic Effects

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

Conclusion

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

Conflict of interest: Authors do not have any conflict of interest to declare.

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Human/Animal Rights: No human or animal rights are violated during this study.

References

1. Baradaran, A., H. Nasri, and M. Rafieian-Kopaei, *Protection of renal tubular cells by antioxidants: current knowledge and new trends.* Cell Journal (Yakhteh), 2015. **16**(4): p. 568.
2. Osbornová-Kosinová, J., *Notes on the synanthropic plants of Egypt.* Folia Geobotanica et Phytotaxonomica, 1984. **19**(3): p. 279-285.
3. Mir, G.M. and S.A. John, *Ethno-medicinal study of Pulwama tehsil (Jammu and Kashmir).* Journal of medicinal plants studies, 2014. **2**(4): p. 5-8.
4. Salam, I., A. Moinuddin, and T.-A. Syed, *Allelopathic effect of Scarlet pimpernel (Anagallis arvensis) on seed germination and radical elongation of mung bean and pearl millet.* Pakistan Journal of Botany, 2011. **43**(1): p. 351-355.
5. Sharifi-Rad, J., et al., *Exploration of phytochemical and antibacterial potentiality of Anagallis arvensis L. extract against methicillin-resistant Staphylococcus aureus (MRSA).* Biotechnology Journal International, 2016: p. 1-8.
6. Sayanova, O., J.A. Napier, and P.R. Shewry, *Δ6-Unsaturated fatty acids in species and tissues of the Primulaceae.* Phytochemistry, 1999. **52**(3): p. 419-422.
7. Gibbs, P. and S. Talavera, *Breeding system studies with three species of Anagallis (Primulaceae): self-incompatibility and reduced female fertility in A. monelli L.* Annals of Botany, 2001. **88**(1): p. 139-144.
8. Bajaj, Y., *Anagallis arvensis L.(Common Pimpernel): In vitro culture, regeneration of plants, and the formation of anagalline and other saponins*, in *Medicinal and Aromatic Plants XI*1999, Springer. p. 1-10.
9. Ibrahim, A.M. and S.I. Ghoname, *Molluscicidal impacts of Anagallis arvensis aqueous extract on biological, hormonal, histological and molecular aspects of Biomphalaria alexandrina snails.* Experimental parasitology, 2018. **192**: p. 36-41.
10. Morozowska, M. and M. Wesołowska, *In vitro clonal propagation of Primula veris L. and preliminary phytochemical analysis.* Acta Biol. Cracov. Bot, 2004. **46**: p. 169-175.
11. Hasan, S.R., et al., *DPPH free radical scavenging activity of some Bangladeshi medicinal plants.* Journal of Medicinal plants research, 2009. **3**(11): p. 875-879.
12. Asolkar, L. and R. Chopra, *Second supplement to glossary of Indian medicinal plants with active principles*1992: Publications & Information Directorate.
13. Yusuf, M., et al., *Medicinal plants of Bangladesh.* Bangladesh Council of Scientific and Industrial Research, Dhaka, Bangladesh, 1994. **192**.
14. Wadood, A., et al., *Phytochemical analysis of medicinal plants occurring in local area of Mardan.* Biochem Anal Biochem, 2013. **2**(4): p. 1-4
15. Harborne, J., *Comparative biochemistry of the flavonoids—VII: Correlations between flavonoid pigmentation and systematics in the family Primulaceae.* Phytochemistry, 1968. **7**(8): p. 1215-1230.
16. Nene, Y. and P. Thapliyal, *Antifungal properties of Anagallis arvensis L. extract.* Naturwissenschaften, 1965. **52**(4): p. 89-90.
17. Ali-Shtayeh, M. and S.I. Abu Ghdeib, *Antifungal activity of plant extracts against dermatophytes.* mycoses, 1999. **42**(11-12): p. 665-672.
18. Aliotta, G., et al., *An oleanane triterpene from Anagallis arvensis.* Phytochemistry, 1992. **31**(3): p. 929-933.
19. Kawashty, S., I. El-Garf, and S. El-Negoumy, *Chemosystematics of Anagallis arvensis L.(Primulaceae).* Biochemical systematics and ecology, 1998. **26**(6): p. 663-668.
43.
20. Amoros, M., B. Fauconnier, and R. Girre, *In vitro antiviral activity of a saponin from Anagallis arvensis, Primulaceae, against herpes simplex virus and poliovirus.* Antiviral research, 1987. **8**(1): p. 13-25.
21. Rasooli, I., *Bioactive compounds in phytomedicine*2012: BoD–Books on Demand.
22. Cai, Y., et al., *Cucurbitacins: A systematic review of the phytochemistry and anticancer activity.* The American journal of Chinese medicine, 2015. **43**(07): p. 1331-1350.
23. Ishikura, N., *Flavonoids in the petal cells of Anagallis arvensis f. coerulea containing a blue crystalline anthocyanin.* Zeitschrift für Pflanzenphysiologie, 1981. **103**(5): p. 469-473.
24. Yamada, Y., et al., *Cucurbitacins from Anagallis arvensis.* Phytochemistry (UK), 1978.
25. Viegi, L., et al., *A review of plants used in folk veterinary medicine in Italy as basis for a databank.* Journal of Ethnopharmacology, 2003. **89**(2-3): p. 221-244.
26. Akerreta, S., et al., *Analyzing factors that influence the folk use and phytonomy of 18 medicinal plants in Navarra.* Journal of ethnobiology and ethnomedicine, 2007. **3**(1): p. 16.
27. López, V., R.Y. Cavero, and M.I. Calvo, *Cytotoxic effects of Anagallis arvensis and Anagallis foemina in neuronal and colonic adenocarcinoma cell lines.* Pharmacognosy Journal, 2013. **5**(1): p. 2-5.
28. Bhatia, H., et al., *Ethnomedicinal plants used by the villagers of district Udhampur, J&K, India.* Journal of Ethnopharmacology, 2014. **151**(2): p. 1005-1018.
29. Karki, Y.B., *Fertility and the value of children: A study of rural and urban populations in Nepal*, 1982.
30. Tiwari, S., *Plants: A rich source of herbal medicine.* Journal of natural products, 2008. **1**(0): p. 27-35.
31. Cavero, R., S. Akerreta, and M. Calvo, *Medicinal plants used for dermatological affections in Navarra and their pharmacological validation.* Journal of Ethnopharmacology, 2013. **149**(2): p. 533-542.
32. Gairola, S., et al., *Herbal antitussives and expectorants—a review.* International Journal of Pharmaceutical Sciences Review and Research, 2010. **5**(2): p. 5-9.
33. Hainer, B.L., *Dermatophyte infections.* American family physician, 2003. **67**(1): p. 101-108.
34. Chermette, R., L. Ferreiro, and J. Guillot, *Dermatophytoses in animals.* Mycopathologia, 2008. **166**(5-6): p. 385-405.
35. Soares, L.A., et al., *Anti dermatophytic therapy: prospects for the discovery of new drugs from natural products.* Brazilian Journal of Microbiology, 2013. **44**(4): p. 1035-1041.
36. López, V., et al., *Pharmacological properties of Anagallis arvensis L.("scarlet pimpernel") and Anagallis foemina Mill.("blue pimpernel") traditionally used as wound healing remedies in Navarra (Spain).* Journal of Ethnopharmacology, 2011. **134**(3): p. 1014-1017.
37. Ali-Shtayeh, M., et al., *Antimicrobial activity of 20 plants used in folkloric medicine in the Palestinian area.* Journal of Ethnopharmacology, 1998. **60**(3): p. 265-271.
38. Abdel-Gawad, M.M., et al., *Molluscicidal saponins from Anagallis arvensis against schistosome intermediate hosts.* Japanese journal of infectious diseases, 2000. **53**(1): p. 17-19.
39. Vermeersch, M., et al., *Selective antileishmania activity of 13, 28-epoxy-oleanane and related triterpene saponins from the plant families Myrsinaceae, Primulaceae, Aceraceae and Icacinaceae.* Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives, 2009. **23**(10): p. 1404-1410.
40. Amoros, M., B. Fauconnier, and R.-L. Girre, *Effect of saponins from Anagallis arvensis on experimental herpes simplex keratitis in rabbits.* Planta medica, 1988. **54**(02): p. 128-131.
41. Ibrahim, A.M. and S.I. Ghoname, *Molluscicidal impacts of Anagallis arvensis aqueous extract on biological, hormonal, histological and molecular aspects of Biomphalaria alexandrina snails.* Experimental parasitology, 2018. **192**: p. 36-41.
42. Mohamed, G.A., S.R. Ibrahim, and R.A. Al Haidari, *A review on natural contraceptive agents.* Am. J. PharmTech Res, 2014. **4**(3): p. 124-158