

A review on the medicinal activities of *Andrographis paniculata*

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Received: March 2, 2018 | Accepted: May 08, 2018 | Published online – May 15, 2018

Abstract

Andrographis paniculata, commonly known as Kalmegh, is one of the most popular medicinally important plants in India. The main constituents of this plant are two lactone diterpenoids namely andrographolide and deoxy-andrographolide. It is used traditionally for the treatment of several diseases such as diabetes, high blood pressure, ulcer, skin diseases, cancer and malaria since ancient times. In this review, the medicinal properties of *Andrographis paniculata* and its chemical constituents have been discussed.

Keywords: *Andrographis paniculata*, andrographolide, deoxy-andrographolide, medicinal properties

1. Introduction

Plants are the source of various renewable chemicals. In recent times organic chemists have switched their attention to the plant based chemicals as these are renewable and mostly non toxic in nature.^{1,2,3,4,5,6,7,8} Medicinal plants are used for the prevention of diseases since the early stages of human civilization. *Andrographis paniculata* commonly known as Kalmegh belongs to the family Acanthaceae. This plant is called as “king of bitters” probably due to its bitter taste. *Andrographis paniculata* is native to India, China, Taiwan and many other Asian countries. *Andrographis paniculata* has been used for the treatment of several diseases such as diabetes, skin diseases, ulcer, high blood pressure, malaria and cancer etc. The major isolable chemical constituent of *Andrographis paniculata* is a diterpenoid andrographolide **1** (Figure 1). The presence of

other chemical components such as deoxy-andrographolide **2**, neo-andrographolide **3** and several flavanoids (**4** - **9**) have also been reported (Figure 1, 4). The medicinal importance of *Andrographis paniculata* along with its chemical constituents have been discussed in this review.

2. Plant Description

Andrographis paniculata is medicinally important plant which belongs to *Andrographis* genus. It is an annual, branched, herbaceous plant of height 30 – 110 cm with dark green stem of length 30 – 100 cm and having diameter 2 – 6 mm. Leaves are simple, opposite, glabrous, lanceolate, 2–6 cm long, 1–3 cm wide with margin acute. *Andrographis paniculata* is a flowering plant and the flowers are white with rose-purple spots on the petals. Seeds are very small, subquadrate.⁹

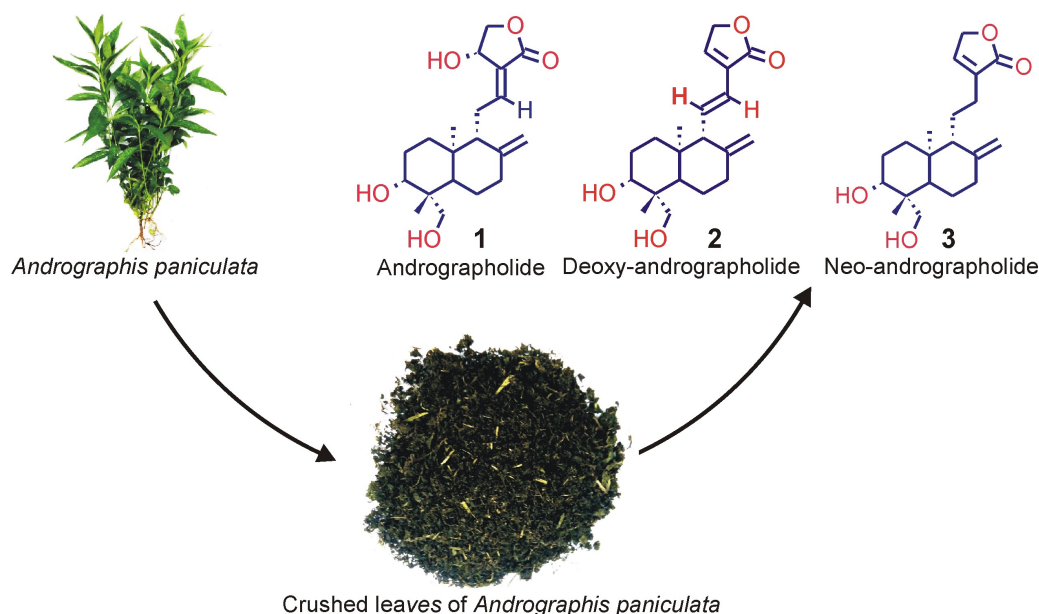


Figure 1: Extraction of Andrographolide and deoxy andrographolide from *Andrographis paniculata*

3. Medicinal Use

The whole parts of the plant have been used as traditional medicine in Asia from ancient. Andrographolide, a major labdane diterpenoid of *Andrographis paniculata*, is the largest contributor of many pharmacological activities (Figure 2). Other chemicals such as labdane diterpenoid 14-deoxyandrographolide, quinic acids, flavonoids and xanthenes are also reported for their significant contributions.

the cell and leading to cancer. The anti-inflammatory activity of *Andrographis paniculata* has been reported individually by many investigators.^{10,11,12} Sheeja et al. have been reported protective effects of *Andrographis paniculata* against cyclophosphamide (CTX)-induced toxicity *in vivo* and suggests that extract could suppressed the CTX-induced intestinal damage.

3.3 Anti-microbial activity

Aqueous extract of *Andrographis paniculata* has

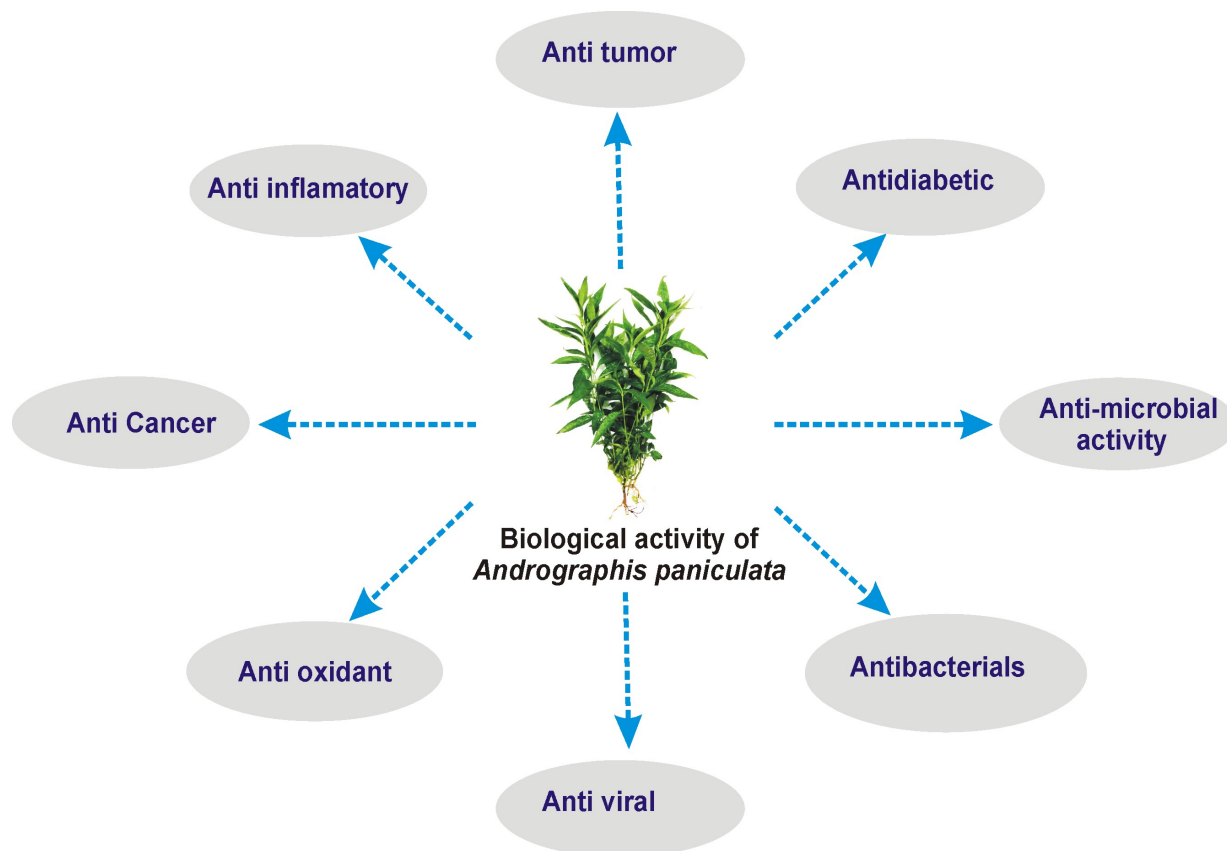


Figure 2: Schematic presentation of biological activity of *Andrographis paniculata*

3.1 Effect on Common Cold

In several communities *Andrographis paniculata* is commonly used for the prevention and treatment of common cold. The effect of dried extract of *Andrographis paniculata* on common cold was reported by Hossain et al.⁹. The common cold patients have used a tablet made from dried extract of *Andrographis paniculata* and significant improvement was observed.

3.2 Anti-Inflammatory Effect

The anti-inflammatory activity is highly linked with cancer and diabetes. The chronic inflammation may damage

anti-microbial activity against *Bacillus subtilis* (B. subtilis), *Pseudomonas aeruginosa* (P. aeruginosa), *Escherichia coli* (E. coli). All three were also active against B. subtilis.¹³ The extract of *Andrographis paniculata* has been used in Indian medicinal system for reduction of microbial infections.

3.4 Anti-bacterials

Antibacterial activity of the ethanolic extract of *Andrographis paniculata* has been reported by Rajeswari et al. The ethanolic extract of *Andrographis paniculata* showed inhibitory activity towards *Klebsiella pneumonia* (23 mm), *Staphylococcus aureus* (26 mm), *Pseudomonas aeruginosa* (19 mm), *Escherichia coli* (21 mm). The extract of

Andrographis paniculata reduced diarrhea and other diseases from bacterial infection.¹⁴

3.5 Anti-virals

The antiviral activities against some DNA and RNA viruses have shown from extracts of some medicinal important plants. Among these medicinally plants, *Andrographis paniculata* have shown activity against the human immunodeficiency virus (HIV).¹⁵ *Andrographis paniculata* extracts have shown antiviral activity against herpes simplex.¹⁶

3.6 Anti-diabetic

For diabetic patients, there are many plants are

used for the suppression of diabetes. *Andrographis paniculata* is very common for that purpose. The anti-diabetic activity of *Andrographis paniculata* have been reported by Husen et al and Borhanuddin et al using aqueous extract.^{17,18} The extract of *Andrographis paniculata* lower the blood glucose level.^{19,20}

3.7 Anti-cancer

Andrographis paniculata extract have shown anti cancer activity. The extract have potent cytotoxic activity against P388 (lymphocytic leukemia) cells and KB (human epidermoid leukemia). The extract inhibit proliferation of various cell line.^{21,22}

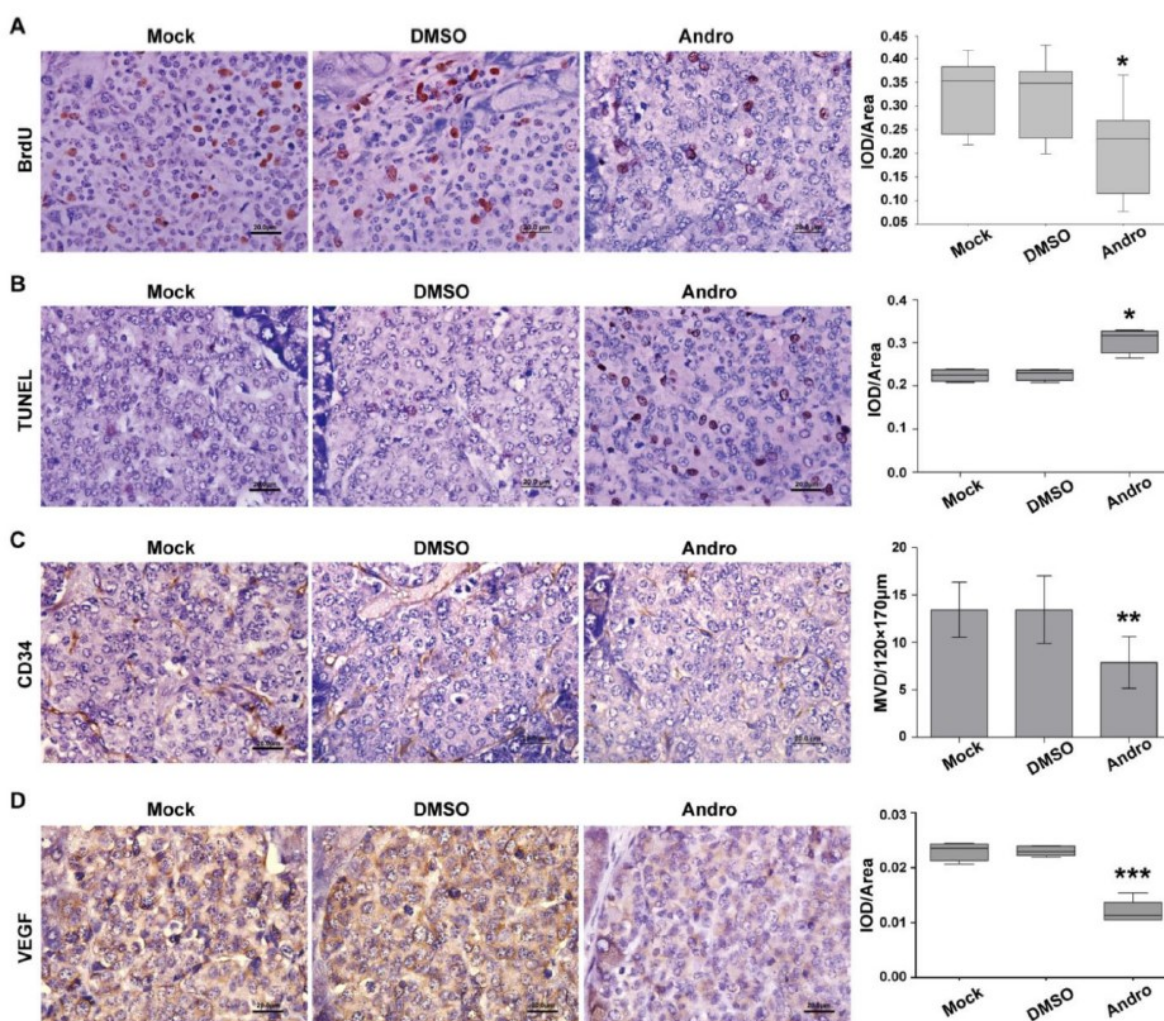
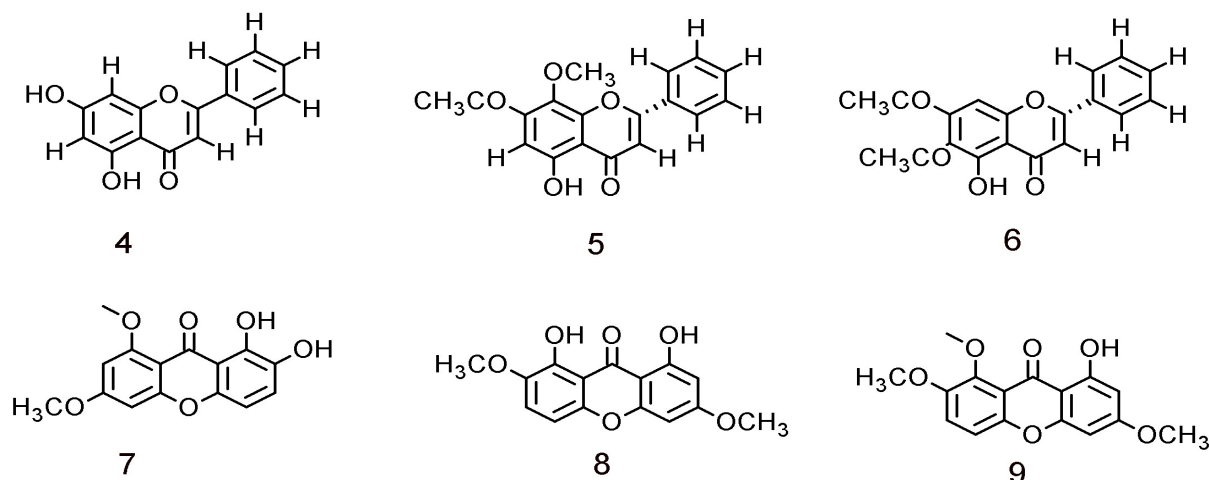


Figure 3: Andrographolide inhibits cell proliferation and angiogenesis and induces cell apoptosis in insulinoma. (A) Andrographolide inhibited the tumor cell proliferation, which was measured using the BrdU cell proliferation assay, in RIP1-Tag2 mice. (B) Cell apoptosis was increased, which was examined through TUNEL staining, in Andrographolide treated tumor tissue compared with control groups. (C) and (D) Andrographolide suppressed the tumor angiogenesis, which was measured using the immunohistochemical staining of CD34 and VEGF, in RIP1-Tag2 mice. n=6, * $P < 0.05$, ** $P < 0.01$. Bar, 20 μ m. Reproduced from ref. 23 with permission of *IJBS*.

Figure 4: Flavanoids presents in *Andrographis paniculata*

3.8 Anti-tumor

Anti tumor activity of of *Andrographis paniculata* has been reported by Zhang and Ding et al. The diterpenoid andrographolide is the major plant chemical of *Andrographis paniculata*. They show that andrographolide inhibit tumor growth at initial stage as well as at the advance stage of insulinoma through targeting the TLR4/NF- κ B signaling pathway (Figure 3).²³

4. Chemical structures

Andrographolide and deoxy-andrographolide are bicyclic diterpenoid γ -lactone (Figure 1). The diterpenoid andrographolide contain three hydroxyls at C-3 (secondary), C-14 (allylic) and C-19 (primary) and the diterpenoid deoxy andrographolide contain two hydroxyl groups at C-3 (secondary) and C-19 (primary). The presence of other chemical comoponents such as deoxy-andrographolide **2**, neo-andrographolide **3** and several flavanoids (**4** - **9**) have also been reported (Figure 4).

5. Conclusion and Future Prospects

In this review, different biological activities of *Andrographis paniculata* and different chemical constituents have been discussed. Terpenoids having functional properties undergo spontaneously self-assemblies in different neat liquids and aqueous binary lliquid mixtures yielded different supramolecular architectures like vesicles, micelle, tubes, fiber, rod, helices, etc and the functional terpenoids are recognised as '*functional nano entities*'. The diterpenoid andrographolide contains three 'OH'groups at C-3, C-14 and C-19 positions and a lactone moiety along with a lipophilic backbone which makes it an unsymmetrical bola-amphiphile. This structural characteristic will open up its use in studying self-assembly. Studies along these lines are in progress and the results will be reported in due course.

5. Acknowledgement

I thank Professor Braja Gopal Bag for his encouragements. Vidyasagar University is gratefully acknowledged for providing financial support and infrastructural facilities. SG thanks CSIR for providing research fellowships.

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