



## A literary study on kalmegha and its physiological action over different disorders—A review

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### Abstract

*Andrographis paniculata* (Burm.f.) Nees (Acanthaceae) is a medicinal plant traditionally used for the treatment of cold, fever, laryngitis and several infectious diseases ranging from malaria to dysentery and diarrhea in China, India and other south east Asian countries. The plant is claimed to possess immunological, antibacterial, anti-inflammatory, antithrombotic and hepatoprotective properties. In Malaysia, the plant is used in folk medicines to treat diabetes and hypertension. The contents of diterpenoids like andrographolide, neo andrographolide and dehydroandrographolide are the chief criteria for monitoring the quality of *Andrographis paniculata*. Andrographolide, though found in all plant parts, is most concentrated in the leaves. It is a diterpene containing a  $\gamma$ -lactone ring connected to a decalin ring system via an unsaturated C-2 moiety. It has multiple pharmacological properties such as protozoacidal, antihepatotoxic, anti-HIV, anticancer, antitumor, hypoglycemic and hypotensive activities. Andrographolide is an interesting pharmacophore with anticancer and immunomodulatory activities and hence has the potential to be developed as an anticancer chemotherapeutic agent as well. In this review, we have explored the various dimensions of the *Andrographis paniculata* plant and compiled its vast pharmacological applications to comprehend and synthesize the subject of its potential image of multipurpose medicinal agent. The plant is widely cultivated to large regions of the world and its importance as a medicinal plant is growing up substantially with increasing and stronger reports in support of its multifarious therapeutic uses.

**Keywords:** *Kalmegha*, andrographolide, neo andrographolide, hepatoprotective, anticancer, antitumor, anti-HIV, medicinal plant

### Introduction

*Andrographis paniculata* (Burm. f.) Wall. ex Nees (AP) is a significant therapeutic plant and generally utilized all throughout the planet. It has a place with the family Acanthaceae. AP is utilized as a conventional natural medication in Bangladesh, China, Hong Kong, India, Pakistan, Philippines, Malaysia, Indonesia, and India<sup>[1,2]</sup> ayurved is a medical science that gives us a profuse knowledge of *Dravyas* or drugs which we get from plants, animals and minerals. The medicinal plants are the potential source of Ayurvedic medicines and are a core component at primary health care level due to their availability, compatibility and affordability. India is perhaps the richest nation with regard to herbal medicinal wealth (about 15000-20000 plants have been found to have good medicinal value). And it also has the oldest medicinal system in the form of Ayurveda. Ayurvedic classics have mentioned many efficacious herbs to treat a variety of ailments. One such herb is being Kalmegh i.e. *Andrographis paniculata* (Burm.f.) Wall. ex Nees, is a potent hepatoprotective and antifebrile herb.

Modern studies have explicitly revealed that *Andrographis paniculata* has a wide range of pharmacological actions such as anti-inflammatory, anti-diabetes, anti-diarrheal, anti-viral, anti-malarial, hepatoprotective, anti-cancer, anti-human immunodeficiency virus (HIV), immune stimulator and anti-snakebite. Kalmegh, meaning is "dark cloud" because of its appearance from a distance like a black cloud in the blue sky. It is also known as Bhui-neem, meaning "neem of the ground", since the plant, though being a small annual herb, has a similar strong bitter taste as that of the

large Neem tree (*Azadirachta indica*). In different geographical region Kalmegh i.e. *Andrographis paniculata* is termed as Bhunimba, Bhunimo, Desi chirayita etc. Glossary of Vegetable Drugs in Brihatrayi, mentioned that in Madhya Pradesh it is popular in the name of Bhunimba, but in Nagpur area and forests of Bihar it is termed as Chiraita.

In Orissa it is called Bhunimba or Bhunimo. Renowned scholars of Ayurveda, Acharya PriyaVrat Sharma and Bapalal G. Vaidya also mentioned the Bhunimba as a synonym of Kalmegh. In Adarsh Nighantu, Bapalal G. Vaidya has mentioned Kalmegh in Vasadi Varga with synonyms Kalpanath, Yavatikta and Shankhini. According to him Rasa of Kalmegh is *Tikta* and has *Deepaniya*, *Katupaushatik*, *Jwaraghna* and *Yakrit-roga Nashak Karma*. Prof. PriyaVrat Sharma has mentioned Kalmegh in Shatpushpadi Varga with synonyms Bhunimba. Its fruits are Yava shaped and so it is mentioned as Yavatikta in some Nighantus. Its Rasa is *Tikta*, *Guna* is *Laghu-Ruksha*, *Veerya* is *Ushna* and *Karma* is *Kapha-Pitta vinashini*. According to him, it is used as *Deepan*, *Swedan*, *Jwaraghna*, *Kriminashak* and is helpful in *Yakrit roga* and *Kushta*. *Andrographis paniculata* (Burm. F.) Wall. Ex Nees (AP) additionally called Kalmegh or "Ruler of Bitters" has a place with family Acanthaceae. It has been utilized for quite a long time in Asia to treat gastro-intestinal plot and upper respiratory contaminations, fever, herpes, sore throat, and an assortment of other persistent and irresistible sicknesses.

Indian Pharmacopeia portrays that it is a dominating constituent of at any rate 26 Ayurvedic details. In Traditional Chinese Medicine (TCM), *Andrographis* is

considered as the spice having a significant "cold property" helpful to treat the warmth of body in fevers, and to disperse poisons from the body. In Scandinavian nations, it is usually used to forestall and treat regular colds

### Botanical Description

*Andrographis paniculata* nees (Acanthaceae) is a restorative plant customarily utilized for the treatment of mitigating, antibacterial, cancer prevention agent, antiparasitic, antispasmodic, anti diabatic, against cancer-causing, antipyretic, anti diarrhoeal, hepatoprotective, nematocidal, anti HIV and a few irresistible infections going from jungle fever to loose bowels. The plant is broadly utilized in ayurvedic and homeopathic frameworks of prescriptions. The restorative worth of this plant is expected to the presence of dynamic fixings viz andrographolide and neo andrographolide which are subsidiaries of diterpenoids. It forestalls oxidative harm and represses restricting to poisonous metabolites to DNA.

AP is a yearly, stretched, herbaceous plant raising to a stature of 30-110 cm in clammy obscure spots with stem intensely quadrangular, much stretched, effortlessly broken delicate surface stem. Leaves are basic, inverse, lanceolate, glabrous, 2–12cm long, 1–3cm wide with edge intense and whole or marginally undulated and upper leaves regularly bractiform with short petiole. Inflorescence of the plant is described as patent, terminal and axillary in panicle, 10–30 mm long; bract little; pedicel short.

The blossoms have natural highlights of calyx 5-molecule, little, direct; corolla tube tight, around 6 mm long; appendage longer than the cylinder, bilabiate; upper lip elliptical, white with a yellowish top; lower lip comprehensively cuneate, 3-lobed, white with violet markings; stamens 2, embedded in the throat and far exerted; anther basally unshaven. Prevalent ovary, 2-celled; style far exerted. Container of the plant is erect, direct oval, 1–2 cm long and 2–5 mm wide, packed, longitudinally wrinkled on expansive faces, intense at the two closures, meagerly glandular-bristly. Seeds are tiny, subquadrate (1-5).

### Constituents

*Andrographis paniculata* contains diterpenes, lactones and flavonoids. Flavonoids mostly exist in the root, however have likewise been segregated from the leaves. Airborne parts contain alkanes, ketones, and aldehydes and the severe standards in the leaves were because of quality of the lactone andrographolide named kalmeghin. Four lactones – Chuanxinlian A (deoxyandrographolide), B (andrographolide), C (neoandrographolide) and D (14-deoxy-11, 12-didehydroandrographolide) were confined from the aeronautical parts in China. A diterpene glucoside (deoxyandrographolide-19beta-Dglucoside) has been distinguished in the leaves also, six diterpenoids of the ent-labdane type, two diterpene glucosides and four diterpene dimers (bis-andrographolides A, B, C, and D) have been confined from elevated parts. Two flavonoids recognized as 5, 7, 2', 3'- tetramethoxy flavanone and 5-hydroxy-7, 2', 3'- trimethoxy flavone were confined from the entire plant, while 12 new flavonoids and 14 diterpenoids have been accounted for from the aeronautical parts. Two new flavonoid glycosides and another diterpenoids (andrographic corrosive) were as of late detailed, and two new ent-labdane diterpenoids glycosides were secluded from the flying parts

### Anticancer Effect

Andrographolide displayed both immediate and roundabout impacts on disease cells by repressing multiplication of malignancy cells, cell-cycle captures, or cell separation, improving body's own safe framework against malignant growth cells; and drafting apoptosis and rot of malignancy cells.<sup>3</sup> Dichloromethane part of methanol remove altogether repressed the expansion of HT-29 colon malignancy cells. The major bioactive compound of AP, andrographolide, secluded from dichloromethane restrained the development of an assorted malignant growth cell addressing various sorts of human tumors.<sup>4</sup> Interestingly, as of late Aditya *et al.* <sup>[4]</sup> detailed that methanol concentrate of AP was discovered to be less compelling against both MCF-7 bosom and HT-29 colon malignancy cell lines. This low action displayed may be because of the low entrance force of the dynamic standards.

### Hepatoprotective Effect

*A. paniculata* is broadly utilized generally as a hepatoprotective specialist and an animating specialist for various chemicals of the liver. It is likewise utilized as a fixing in the polyherbal arrangements for the treatment of hepatic issues in Ayurvedic and Unani medication <sup>[6]</sup>. Alongside various concentrates of AP, andrographolide, neoandrographolide, 14-dexoyandrographolide, and 14-deoxy-11,12-didehydroandrographolide compounds are likewise answered to have hepatoprotective impact <sup>[7-11]</sup>. In a near report, the leaf concentrate and andrographolide was tried against the carbon tetrachloride-(CCl<sub>4</sub>-) instigated hepatic microsomal lipid peroxidation. Just the leaf remove totally ensured the high focus CCl<sub>4</sub>-actuated microsomal lipid peroxidation in vitro yet not the andrographolide, which demonstrated that the hepatoprotective job isn't exclusively because of the presence of andrographolide <sup>[12]</sup>. Comparative impact of rough liquor concentrates of the AP leaves against CCl<sub>4</sub>-initiated liver harm was likewise revealed by Rana and Avadhoot <sup>[13]</sup>. Handa and Sharma<sup>14</sup> detailed that andrographolide, methanol concentrate of entire plant, and without andrographolide methanol remove improved liver histology in rodents by 48.6%, 32%, and 15%, separately, after CCl<sub>4</sub>-instigated liver injury. Verma *et al.* <sup>[15]</sup>. Announced the impact of ethanol concentrate of AP on reclamation of various protein after CCl<sub>4</sub>-prompted liver injury. Further examination utilizing explicit bioactive mixtures is requesting for the better comprehension of the hepatoprotective pretended by the AP.

### Cardiovascular Effect

Cardiovascular sicknesses (CVDs) are the main source of death all through the world. AP is utilized generally for improving the cardiovascular wellbeing in customary therapeutic frameworks. A few examinations have researched its exercises in cardiovascular sicknesses <sup>[16-21]</sup>. Wang *et al.* <sup>[22]</sup> revealed that AP is potential to build the nitric oxide, cyclic guanosine monophosphate, and superoxide dismutase action with decays of lipid peroxide and endothelin in an atherosclerotic bunny model. In another examination, Wang and Zhao <sup>[23]</sup> additionally explored that the AP concentrates can have the option to forestall tightening of veins and increment blood coagulating time fundamentally in the pre-and postangioplasty techniques. The concentrates restrained the cell development and DNA amalgamation in a portion

subordinate way, which is a comparable instrument like stents that forestall cell division.

### Immunomodulatory Effect

Control of resistant reaction by directing atomic factor of initiated T cells (NFAT), a record factor fundamental for cytokine creation during T-cell actuation, is a generally known system. Forestalling movement of NFAT to core is the objective of a few immunosuppressive specialists (e.g., cyclosporin A, FK506) [24]. AP is known to apply a few immunomodulatory properties. Over twenty years prior, a research facility test exhibited that AP hindered development of human bosom malignant growth cells like the medication tamoxifen [25]. Amroyan *et al.* [26] revealed that andrographolide was successful to stop the amassing of blood platelets that lead to cardiovascular failures and they likewise recommended that andrographolide has a significant impact on initiating the overall protection elements of resistant framework by animating the creation of antibodies just as vague insusceptible reactions, for example, expanded macrophage phagocytosis. An in vitro concentrate with the expanded multiplication of lymphocytes and creation of interleukin-2 (IL-2) affirmed the immunostimulatory action of AP [27].

### Antihyperglycemic Effect

Hindrances of  $\alpha$ -glycosidase and  $\alpha$ -amylase action and incitement of insulin affectability are considered as powerful procedures to bring down the degree of postprandial blood glucose. These compounds engaged with processing and assimilation of sugars bringing about postprandial increment of blood glucose [28]. Insulin obstruction is fundamentally communicated by hyperinsulinemia and high blood glucose level and is related for certain metabolic hormonal anomalies, for example, dyslipidemia, unusual uric corrosive digestion, expanded ovarian testosterone emission, endothelial brokenness, raised procoagulant factors, and raised fiery markers [29].

### Conclusion

The interest of AP is significantly expanded in the previous few years for its staggering restorative possibilities. Accessible information on AP additionally obviously communicates an expansive range of pharmacological properties of this plant. Due to having broad pharmacological exercises, the AP can be securely viewed as one of the cutting edge catholicons. In any case, the explored pharmacological exercises of AP need approval through the clinical examination. Despite the fact that few clinical examinations were effectively finished without unfriendly impacts or fatalities, the greater part of them just explored upper respiratory parcel diseases for an assortment of conditions. Check of the adequacy of other organic exercises of AP including antidiabetic, anticancer, calming, and hepatoprotective exercises, on human investigation subjects would bring a ton of advantages for the biggest populace of the globe. We expect that the AP could be valuable as profoundly applied restorative specialists for an assortment of issues sooner rather than later to fix human illnesses just as some creature infections. To satisfy this fantasy, the specialists may zero in on duplication of this plant to fulfill business need other than the pharmacology study. Tissue culture methods may be a decent choice to make AP accessible for investigates (i.e., pharmacological

examination and phytochemical study to discover new bioactive mixtures) just as preservation of this plant.

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