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Phytochemical, Pharmacological & Antiviral Studies Of Andrographis Paniculata-A Review Article

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Abstract

Andrographis paniculata is a valuable herb belong to the family Acanthaceae that has been used traditionally in Indian system of medicine diabetes, viral hepatitis, and malaria The most common and abundant diterpenoid is andrographolide Andrographis and its extract have been documented for their various medicinal uses. A full bibliographic inquiry was conducted using extensively used scientific databases like Web of Science, research articles, and online as well as offline sources. A goal of the current review is to analyze the *Andrographis paniculata*'s traditional usage, chemical components, and biological activities to highlight, explore, and lay the groundwork for future research.

Keywords: *Andrographis paniculata*, Bioactive constituents, Pharmacology, Medicinal Uses Hepatoprotective, Antioxidant Activity, Anti hepatitis "B" Viral Activity

Introduction

Andrographis paniculata commonly known as 'King of Bitter' mahatikta. It generally grows abundantly in Southeast Asia, Sri Lanka, and India. It can increase in height to a maximum of one meter, with small, hairy white to pink blooms and lanceolate leaves. The leaf is the primary therapeutic component, while the entire plant, including the root, is used for a variety of illnesses. In India, it grows in the rainy season, when heat and humidity with lots of sunshine are the ideal climate conditions for the seed Germination. Medicine systems of Ayush make considerable use of *Andrographis paniculata* as a home treatment for various illnesses. The most utilized component of *Andrographis paniculata* is the aerial part, and its major bioactive constituents are diterpenoids, flavonoids, and xanthones.

Ethnobotanical Uses

Indian traditional healers have used the leaves and roots of *Andrographis paniculata* to treat a variety of illnesses like fevers, diarrhea, ETC. The plant is used as a liver tonic.

Bioactive Compounds Of Andrographis

Terpenoids

Terpenoid that are extracted from *Andrographis paniculata's* aerial parts and roots (table 2). The majority of the isolated and recognized diterpenoids from *Andrographis paniculata*, in terms of both quantity and occurrence, are andrographolide, deoxyandrographolide, and

neoandrographolide. Andrographolide is a white, crystalline substance with an extremely unpleasant taste. It has a variety of pharmacological characteristics and was initially extracted in pure form by Gorter in 1911. Andrographolide is an α-alkylidene γ-butyro-lactone molecule with three-OH groups at Carbon-3, 14, and 19 that is found primarily in leaves. Deoxyandrographolide and neoandrographolide are also dominant diterpenoids that are usually found in the aerial parts of plant. Several researchers have isolated these diterpenoids. Other diterpenes besides the prominent ones have also been discovered by several researchers, including a unique terpenoid (23-carbon) found in the plant's roots and aerial parts.

Flavonoids

Extracted from all parts of the herb table -1

Table 1: Bioactive compounds of *Andrographis paniculata*

S. No.	Compounds	Basic structure type	Extracted from plant parts
1	Andrographolide	Diterpenoid lactone	Aerial plants parts
2	Deoxyandrographolide		
3.	Neo-Andrographolide		
4.	Andrographolide D: (14-deoxy-11,12-didehydroAndrographolide)		
5	Andrographolactone		
6.	Andrographanin	Diterpene	Leaves
7.	Andrographoside	Diterpene	Leaves
8.	19-O-β-Dglucopyranosyl-entlabda-8(17) 13-diene-15,16,19-triol entlabdane	Ent-labdane diterpenoids	Aerial plants parts
9.	3-O-β-Dglucopyranosyl-14,19-dideoxy andrographolide		
10.	8-α-methoxy14-deoxy17β-hydroxy andrographolide entlabdane		
11.	5,7,2’,3-tetramethoxy flavones.	Flavonone	All parts of a plant
12.	5-hydroxy-7,2’,3’-trimethoxy flavones	Flavone	All parts of a plant
13.	7-O-methyl-dihydro wogonin		
14.	Flavone-1,2’methylethe		
15.	5-hydroxy-7, 2', 3'-tri methoxyflavones	Flavonoids	All plant parts
16	Dihydroskullcapflavone	Flavone	All plant parts

Table 2: Other Chemical Constituents of *Andrographis paniculata*

S. No.	Chemical constituents	Extracted from a plant part
1.	1,8-dihydroxy-3,7-dimethoxy-xanthone	Root of plant
2.	4,8-dihydroxy-2,7-dimethoxy-xanthone	
3.	1,2-dihydroxy-6,8-dimethoxy-xanthone	
4.	3,7,8-trimethoxy-1-hydroxy-xanthone	
5.	Andrographidoid A-E	
6.	Curvifloruside	
7.	Arabinogalactan	Herbs

microelements (K and Ca) and trace elements (Cr, Mn, Co, Ni, Zn, Cu, Se, Rb, Sr, and Pb) were discovered and measured in the roots.

Pharmacological Properties Of *Andrographis paniculata*

Its usage as a therapeutic agent in the therapy of many illnesses as a result of its use in Ayurvedic medicine, particularly in India. Studies have revealed that this plant have variety of biological activities, including antioxidant activity, anti-bacterial, anti-viral, and fever, urinary tract infection, and anti-diabetic activity, cardiovascular activity, immunomodulatory activity and anti-hepatotoxic, etc

(1) Antioxidant Activity

A study of Verma et al., observed that how Kelmegh's aqueous extract affected the hepatic defense system in AKR mice having lymphoma . He also observed that taking an oral dose of a plant's aqueous extract considerably increased the activity rate of glutathione-s-transferase, catalase, and superoxide dismutase. Andrographolide significantly affected the hepatic antioxidant defense system and lipid oxidation in control mice, according to Das et al.,. Its hepato-protective reactivity against hexa-chloro cyclohexane was also tested for oxidative injury. He discovered that plant extract and active ingredient andrographolide exhibits a antiradical activities against several pathophysiological oxidants using liver sub-cellular organelles of rat as model systems . When the plant's antioxidant and anti-inflammatory properties were investigated, it was discovered that the methanolic extract inhibits the production of free radicals such as superoxide, hydroxyl radicals and nitric oxide in vitro system . The RAW cells stimulated with lipo-polysaccharide (LPS), andrographolide decrease nitric oxide formation and stabilize the inducible synthase protein . Neoandrographolide, which was an extract from the EtOAc portion of methanol extract, inhibits in vitro and ex vivo NO production in Bacillus Calmette-Guéin (BCG)-induced peritoneal macrophages in mice.

(2) Anti-microbial Activity

A study found that Andrographis water extract may have potential antibacterial effects on both strains of bacteria. According to Wiart *et al.*, *Andrographis paniculata* Nees' ent-labdane diterpenes reduced the propagation of the herpes virus and had no discernible lethal effects at viricidal concentrations. At 0.05 mg/ml concentration, the leaves of *Andrographis paniculata* to reduce body temperatures and relieve fever. According to Misra *et al.*, a methanolic extract of kalmegh has antimalarial action against the malaria-causing organism *Plasmodium berghei* .

(3) Anti-malarial Activity

Ayurvedic Doctors have utilized the leaves of *Andrographis paniculata* to treat fever and reduce body temperatures. According to Misra *et al.*, Kalmegh's methanolic extract exhibits anti-malarial efficacy against *Plasmodium berghei*, malaria-transmitting parasites . The extract clearly demonstrates suppression of the parasite's ability to reproduce. It has also been found that the lactate dehydrogenase (LDH) assay can inhibit anti-malarial efficacy against *Plasmodium falciparum* . Compounds 1, 2-dihydroxy-6, 8-dimethoxyxanthone, which has an IC_{50} value of 4 μg/ml, were found to have significant anti-plasmodial action against *Plasmodium falciparum in vitro* experiments. The most active xanthones were those with hydroxyl groups in the second position, while those with the hydroxyl group in the first, fourth, or eighth positions had very little activity .

(4) Antidiabetic Activity

According to a study on blood glucose, when an Ayurvedic formulation supplemented with this plant, i.e., IIogen-Excel, is taken orally for 60 d, total hemoglobin, hepatic glycogen, and plasma insulin levels all increase while blood glucose levels are markedly reduced . Researchers studied how the plant influenced the estrous cyclicity of rats that had been given alloxan to make them diabetic, and they found that Kalmegh has the ability to reverse the rats' abnormal estrous cycles. It was also reported that water extract (1 g/kg body weight) had a significant (P 0.001) hypoglycemic effect on experimental rabbits . In a dose-dependent way, andrographolide oral therapy reduced the levels of plasma glucose in streptozotocin-induced diabetic rats

(5) Immunomodulatory activity

Andrographolide has immunostimulant and suppressive properties. A diterpene lactone called andrographolide has been found to have immunomodulatory properties that are linked to increased human peripheral blood lymphocyte proliferation, key cytokine production, and the total blood cells have increased immunological activation marker expression (like INF-, neopterin, and 2-microglobulin). HPBLs (human peripheral blood lymphocytes) were activated

by the immune stimulatory action of andrographolide described *in vitro* PHA through increased cell proliferation and IL-2 production. Additionally, it has been noted that andrographolide prevented macrophages activated by lipopolysaccharide from producing TNF and IL-12. According to reports, the plant is a powerful immune system booster, and andrographolide can effectively suppress T-cell stimulation .

(6) Hepato-protective & Anti hepatitis "B" virus Activity

Bhartiya medical systems, *Andrographis paniculata* is commonly utilised as a hepatostimulant and hepatoprotective. The hepatoprotective activity of *Andrographis paniculata* was reported by many groups of researchers. There is few research on the impact of *Andrographis paniculata* crude extracts on liver function. Andrographolide, a typical hepatoprotective drug, was found to be more effective (0.75–12 mg/kg) in a comparative analysis than silymarin . discovered that Extract of Andrographis-Paniculata might effectively heal hepatitis "B" Viral Infection.

Table 03 A Clinical trial On Hepatitis "B" Patient

Usable Pant	Dose	Duration	Pathological Test Reports		Annexure
Ext of Andrographis paniculata	2 Gream 3 Times per Day	11 March to 19 July 2025	*Before Treatment* **HbsAg** **+ REACTIVE** USG Report Hepatomegaly Anti HBS - 00	*After Treatment* **HbsAg** **- Non Reactive** USG Normal Anti HBS - 47.98	 01 & 02 03 & 04

Conclusion

Andrographis paniculata are used against various bioactivities, such as antioxidant, anti-inflammatory, anti-microbial, anti-malarial, anti-cold and fever, anti-viral, hepatoprotective anti-diabetic, cardiovascular activity, and immunomodulatory activity. The major chemical constituents are diterpenoids, flavonoids, and polyphenols present on the aerial part of the plant. Andrographolide is one of the most prevalent and prolific diterpenoids. It treats and prevents a number of human ailments. *Andrographis paniculata* has seen a significant surge in demand in recent years due to its incredible medicinal potential. Numerous clinical trials were conducted without any negative outcomes, proving the plant's safety and significance for

people. Cultivation can be an excellent alternative to satisfy business demand. To learn more about novel bioactive compounds and improve the bioactivity of the original chemicals, more research is still required.

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Authors Contributions
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