PHYTOCHEMISTRY AND ETHNOPHARMOCOLOGICAL IMPORTANCE OF *ANDROGRAPHIS PANICULATA* (BURM.F) NEES

Abstract

Andrographis paniculata (Burm. F) Nees is an annual, upright, branching and herbaceous plant which belongs to the family of Acanthaceae and widely used as medicine in numerous formulations like Ayush, Ayurveda, Siddha and Homoeopathy. It is extensively used to treat a diverse range of ailments, including diarrhoea, dysentery, cold, cough, fever, leprosy, depression, tuberculosis, jaundice, malaria, rheumatism, arthritis, herpes and multiple sclerosis. Additionally, the herb possesses different pharmacological activities such as anti-inflammatory, antioxidant, antifertility, antibacterial, antidiabetic, antimalarial, cardioprotective, hepatoprotective, anti-HIV and anti-cancer etc. The therapeutic value of this plant is because of the presence of active compounds, andrographolide and neoandrographolide, which are derivatives of the diterpinoids. This current article delineates the distribution, chemical composition and pharmacology activitity of Andrographis paniculata. Finally, it draws the attention of the readers towards the utilization of this plant as a potent therapeutic drug.

Keywords: Andrographics paniculata, Andrographolide, ethopharmacology, Medicinal plant, anti-cancer, anti-malarial

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I. INTRODUCTION

Andrographis paniculata (Burm. F) Nees, an herbaceous plant belonging to Acanthaceae family, is often known as the "King of Bitters," The plant is indigenous to tropical and subtropical Asia as well as Southeast Asia and India. It is also referred to as “Senshinren" in Japan, "FahTha Lai" in Thailand, "Kalmegh" in India, "Chuan-Xin-Lian" in China, "Hempedubumi" in Malaysia, " and "Green chiretta" in Scandinavian nation.[1] The major components of A. paniculata are utilized to cure a variety of illnesses, such as immunostimulatory, antiviral, and antibacterial problems. The primary active ingredient and rographolide, has a variety of biological properties like antioxidant, anti-inflammatory, antibacterial, antidiabetic, anticancer, hepatoprotective, anti-HIV, antimalarial and antivenom.[2-12] The herb has been widely used in eastern and ayurvedic medicine since antiquity. There are about 40 species reported and few are often used in folk medicine to treat a variety of illnesses. [3, 13] This article emphasises the chemical components of A. paniculata and their ethanopharmacological significance for treating various diseases.

II. DISTRIBUTION AND MORPHOLOGY

A paniculata is usually found in solitary patches in tropical and subtropical Asian countries. It is native to India, China and Taiwan. This herb grows well in different habitats, such as hill slopes, plains, moist shady area, farms, dry or wetlands, seashores, waste places and road sides. South India and Sri Lanka are home to a large native population of A. paniculata, which may the source of the species’ diversity and origin. The plant is also distributed in India, West Indies, Indonesia, Malaysia and some northern part of America. Its widespread use can be attributed to the fact that it is presumably present in the plains and hills up to 500 m in India. This herb has been used for treating many illnesses in India's ancient villages and ethnic communities for a long time.[1, 3, 14]

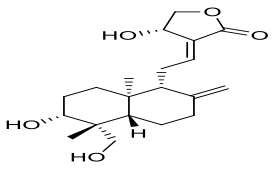
1. **Morphological description:** A paniculata is an annual herbaceous plant which grows well in wet, shaded areas to a height of 30 to 110 cm. The stem of this plant is acutely quadrangular, heavily branched, and readily broken fragile. Leaves are simple, opposite, glabrous, lanceolate, 1-3 cm in width and 2-12 cm in length with an acute and entire or slightly undulate. The upper leaves of the plant are bractiform and have a short petiole. The inflorescence is terminal, patent and axillary in panicle with the length of 10–30 mm; tiny bract with a short pedicel.

Kingdom: Plantae
Division: Angiosperma
Class: Dicotyledonae
Subclass: Gamopetalae
Series: Bicarpellatae
Order: Personales
Family: Acanthaceae
Genus: *Andrographis*
Species: *A. paniculata (*Burm. f.*)* Nees

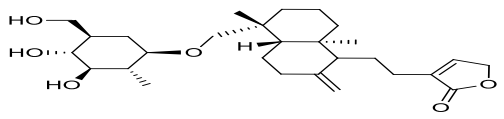
The flowers have the following taxonomic characteristics: calyx linear and small, 5-particle, small; 6-mm-long corolla tube; bilabiate; limb longer than the tube; upper lip oblong; 3-lobed,2- stamens that are inserted in the throat and protrude far; and an anther that is bearded at the base; 2-celled superior ovary with a prominent style. The plant capsule is upright, linear-oblong, longitudinally grooved on broad sides, compressed, sharp at both ends, and sparsely glandular-haired. It measures 1-2 cm in length and 2-5 mm in width. Seeds are sub-quadrate and extremely tiny.[1]

III. CHEMICAL COMPOSITION OF A. PANICULATA

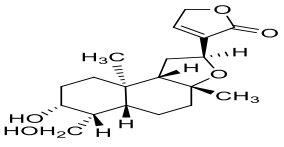
The various secondary metabolites found in A. paniculata include flavonoids, lactones, and diterpenes. The leaves of A. paniculata mainly contains of bitter compounds like andrographolide **(1)**, neoandrographolide **(2)** and Iso-andrographolide **(3).** The other major compoundsfound in this plant are14-deoxyandrographolide **(4)**, 14-deoxy-11-oxoandrographolide **(5),** 3-O-b-D-glucosyl-deoxyandrographolide **(6),** 14-deoxy-12 dehydroxiandrographolide **(7),** 3-O-b-D-glucopyranosyl-14,19-dideoxyandrographolide **(8),** 3-O-b-D-glucospyranoylandrographolide **(9),** 8,17-Epoxy-14-deoxyandrographolide **(10),** 14-Deoxy-17-b-hydroxyandrographolide **(11),**19-O-[b-D-apiofuranosyl-b-D-glucopyranoyl]-3,14-dide-oxyandrographolide **(12),** Enchiodinin **(13),** Andrograpanin **(14),** Andrographiside **(15),** 14-deoxy-11,12-didehydroxiandrographolide **(16)**.**[10, 15] [13, 14, 16-19]**



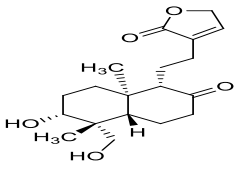
Andrographolide **(1)**



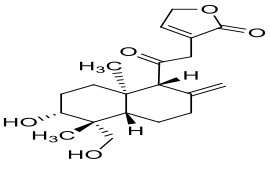
Neoandrographolide **(2)**



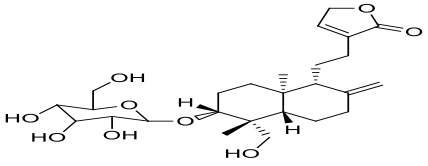
Isoandrographolide **(3)**



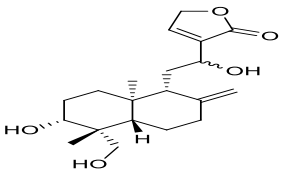
14-deoxyandrographolide **(4)**



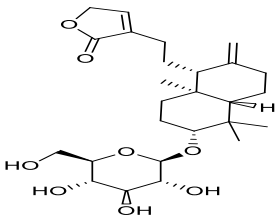
14-deoxy-11-oxoandrographolide **(5)**



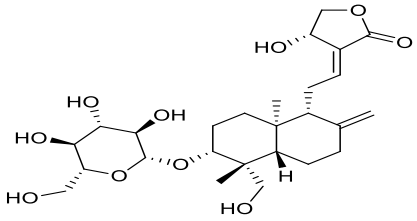
3—O—β-D-glucosyl-deoxyandrographolide **(6)**



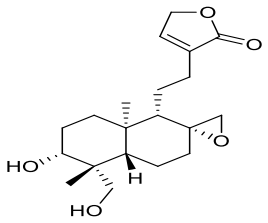
14-deoxy-12-dehydroxi
-andrographolide **(7)**



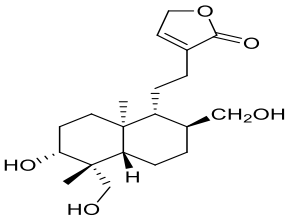
3—O—β-D-glucopyranosyl-14,19-
dideoxyandrographolide **(8)**



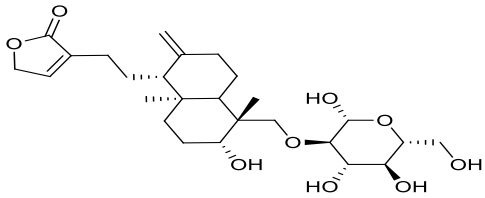
3–O–β-D-glucospyranoylandrographolide **(9)**



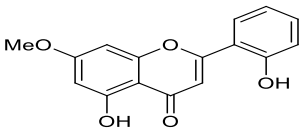
8,17–Epoxy-14-deoxyandrographolide **(10)**



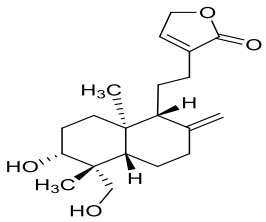
14-Deoxy-17-β-hydroxy
andrographolide **(11)**



19–O–[β-D-apiofuranosyl-β-D-
glucopyranoyl]-3,
14-dide-oxyandrographolide **(12)**



Enchiodinin **(13)**



Andrograpanin **(14)**

Figure 1: Chemical structures of some of the diterpenoids from *Andrographis paniculata*

Deoxyandrographolide and neoandrographolide are two more dominant diterpenoids that have been identified mostly from the aerial parts of A. paniculata. Over the years, several researchers have isolated more diterpenes, including an unique 23-carbon terpenoid that was found in the plant's roots and aerial portions. The primary flavonoids that have been identified from A. paniculata aerial parts, roots, and whole plant are flavones.[13] According to Sharma et. al (2013), the sample collected after 110 days of cultivation contained the highest concentration of andrographolide, followed by that obtained just before the blooming period (130 days).The entire plant, including the aerial parts, leaves and roots were used to extract the bioactive chemicals using a variety of solvents, including ethanol, methanolethanol, acetone, n-hexane, dichloromethane and chloroform.[20]

IV. ETHNOPHARMACOLOGY ACTIVITY

A paniculata has been traditionally used for treating inflammation and other bacterial diseases. The main active ingredient in A. paniculata, andrographolide has a variety of pharmacological actions including those that are anti-inflammatory, anti-obesity, anti-cancer,

anti-diabetic, and more. The species has been linked to a number of medicinal and pharmacological activities, as listed below.

1. **Anti-inflammatory activity:** Andrographis plant extracts containing andrographolide have anti-inflammatory properties. The main effect of andrographolide therapy is to prevent nuclear factor kappa B (NF-kB) from binding to DNA, which reduces the production of pro-inflammatory proteins like nitric oxide synthase (NOS) and cycloxygenase 2 (Cox-2)[21] The discovery that andrographolide decreases cysteine 62 of p50 (a main subunit of NF-kB transcription factors), therefore blocking them from attaching to the promoters of their intended genes was a watershed moment in understanding the mechanism of action of andrographolide.[22] Andrographolide also has an important function in inhibiting Erk 1/2 and Akt signaling, hence limiting macrophage chemo-tactic migration to inflammatory sites.

2. **Immunological potential:** Recent research revealed that A. paniculata extract may be able to reduce the human immunodeficiency virus's (HIV) ability to replicate and that it may be combined with other medications to treat acquired immunodeficiency diseases (AIDS). The important component of A. paniculata, andrographolide, has the ability to interfere with or alter the cellular signal transduction pathway of the virus, interfering with critical enzymes and viral multiplication.[24] A. paniculata has been portrayed by two different approaches as being a potent immune system booster. Antigen-specific immune respone was the first where antibodies were made to fight encroaching pathogens and the second was a general immunological response that scavenged macrophage cells and destroyed invaders

3. **Anti-cancer activity:** Several anti-cancer medicines reduce cancer cell growth by producing necrosis, apoptosis, cell differentiation or cell-cycle arrest; others may have immunomodulatory effect, stimulating own immunological system within the body against malignant cells. The compounds that inhibit several procancer processes are more intriguing since they are more likely to prevent a wider variety of cancers under a variety of circumstances.[4] Andrographolide is a promising prospect as a therapeutic anticancer pharmacophore as it can affect cancer cells both directly and indirectly.[11]

4. **Anti-malarial activity:** Many tropical and subtropical countries still struggle with the serious health issue of malaria. It was demonstrated that A. paniculata strongly inhibits the parasite Plasmodium berghei, which causes malaria.[8] Andrographis protective activity is thought to be related to the revival of superoxide dismutase, one of the essential antioxidant enzyme [5]. In dogs, A. paniculata extracts successfully eliminated filarial that restrict lymph ducts and cause elephantiasis. A. paniculata has also been shown in recent studies to have antimalarial properties against Plasmodium falciparum. [9]

5. **Hepatoprotective activity:** A. paniculata is broadly utilised as a hepatoprotective and hepatostimulative agent in Indian traditional medicine. The aqueous extract of this plant has long been used to treat jaundice and a number of liver conditions. In traditional Ayurvedic medicine, unlike 26 medications, including A. paniculata are utilised to cure liver diseases. The major component of A. paniculata, andrographolide, was demonstrated to be useful in reducing liver damage brought on by carbon tetrachloride (Rats and mice). Additionally, androgrpholide significantly protects the liver from several types of

damages brought on by galactsamine or paracetamole and is more effective than the conventional antioxidant silymarin at preventing a reduction in paracetamole induced bile production. [6, 25]

V. CONCLUSION

The primary active ingredient of A. paniculata, andrographolide, is a diterpenoid lactone with a number of pharmacological actions that have been identified in the systems of Ayurveda, Unani, Siddha, and Chinese medicine. The development of potent formulations containing A. paniculata and its isolated molecule, andrographolide could be pursued using novel herbal drug delivery vehicles, like microparticles or vesicular systems, or by complexing with lipid or other suitable novel carriers. The plant helps in treating cardiovascular illness and reducing liver damage. Additionally, it is quite helpful for issues with the stomach, the body, snakebite, the respiratory system, allergic responses and central nervous system. As a result, this active natural compound may be a good application for pharmacology. In the near future, we would experience the full benefits of using andrographolide for therapeutic purposes.

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