Ethnobotanical and Pharmacological activity of Andrographis Paniculata

[1]Hossein Hassanpour Golshani, [2]Dr Pravin Badhe

[1]Student researcher, [2]Associate professor
Pharmacology department
[1]Sinhgad College of Pharmacy Vadgaon (B.K) Pune
[2]Swalife Biotech Ltd, Cork Ireland

***Abstract*– Andrographis paniculata is one of the highly used potential medicinal plants in the world. It has been used for the treatment of viral to chronic diseases, and as an antioxidant. All parts of this plant are used to extract the active phytochemicals, different secondary metabolites such as glycosides, saponins and terpenoids play important role in the activity.**

In this review, we have discussed its botanical, geographical and pharmacology specially plant extracts and major constituents that have played important role in different diseases.

***Index terms*- Andrographis Paniculata; lead product; natural product; pharmacological activity; Immunomodulatory activity**

I. Introduction

Medicinal plants are prevalent from the origin of the earth and have been efficiently used by ancient people as a treatment for various diseases [6]. The plant extracts are identified and act as an important source of the active ingredient and secondary metabolite products such as alkaloid, glycosides, saponins, tannins and terpenoids, which is used in therapeutic diseases, for drug production and for maintaining good health by both the traditional and orthodox medical practitioners [7,8].

II. Taxonomical classification of Andrographis paniculata:

Kingdom: Plantae, PlantsSub
Kingdom: Tracheobionta, Vascular plants;
Super Division : Spermatophyta, Seed plants;
Division: Angiosperma
Class: Dicotyledonae
Sub class: Gamopetalae
Series: Bicarpellatae
Order: Personales
Tribe: Justicieae
Family: Acanthaceae
Genus: Andrographis
Species: *A. paniculata*(Burm. f) Nees

(**Fig. 1: Andrographis paniculata [4]**)

Andrographis Paniculata (Burm. F.) belongs to the family Acanthaceae. Mostly dried leaves and tender shoots are used in the study. The common name used is Kalmegh, Chirayita, Creat etc. in a different language.
Andrographis paniculata (Burm. F.) Wall. Ex Nees (AP) also called Kalmegh or "King of Bitters" belongs to family Acanthaceae[5]. It has been used for centuries in Asia to treat gastro-intestinal tract and upper respiratory infections, fever, herpes,

sore throat, and a variety of other chronic and infectious diseases[6.7]. It is an annual and branched plant with lanceolate green leaves and attains heights of 60-70 cm. It grows abundantly in Asian countries like India, Sri Lanka, Pakistan, Java, Malaysia and Indonesia and is one of the commonly used medicinal plants in Ayurvedic and Unani systems of medicines. The plant is also known as the 'king of bitters' because it is extremely bitter in taste in every part of plant body [8,9].
Andrographis paniculata (Nees), is a valuable traditional medicinal plant and it has many important bioactive compounds [10]. It cures and prevents a number of diseases in human beings. It cures a cold, fever, colic pain, active against inflammatory, antidiabetic activity, antioxidant, antifertility, cardiovascular and anti-virus including inhibited HIV [11].

III. BOTANICAL DESCRIPTION:
AP is an annual, branched, herbaceous plant erecting to a height of 30-110 cm in moist shady places with stem acutely quadrangular much-branched, easily broken fragile texture stem. Leaves are simple, opposite, lanceolate, glabrous, 2–12cm long, 1–3cm wide with margin acute and entire or slightly undulated and upper leaves often bractiform with a short petiole. Inflorescence of the plant is characterized as patent, terminal and axillary in panicle, 10–30 mm long; bract small; pedicel short [4,12].
The flowers possess botanical features of calyx 5-particle, small, linear; corolla tube narrow, about 6 mm long; limb longer than the tube, bilabiate; upper lip oblong, white with a yellowish top; lower lip broadly cuneate, 3-lobed, white with violet markings; stamens 2, inserted in the throat and far exserted; anther basally bearded. Superior ovary, 2-celled; style far exserted. The capsule of the plant is erect, linear-oblong, 1–2 cm long and 2–5 mm wide, compressed, longitudinally furrowed on broad faces, acute at both ends, and thinly glandular-hairy. Seeds are very small, subquadratic[12,13]
The current aim of this review is to accumulate the morphological and pharmacological applications of *Andrographis paniculata* as a multipurpose drug showing efficient activity in curing various diseases

IV. Geographical distribution:
The genus Andrographis is composed of roughly 40 species several members of which enjoy a reputation in traditional medicine[14].AP populations are distributed over a broad eco-geographical range in tropical Asian countries often in isolated patches. It grows abundantly in Southern and Southeastern Asia, including India,Sri Lanka, Pakistan and Indonesia [15].
So-called ''native populations'' occur only in the Indian subcontinent and especially South India and Sri Lanka, which perhaps represent the centre of origin and diversity of the species [16,17], stated that the herb is an introduced species in the northern areas of India, Thailand, Brunei, Malaysia, Indonesia, the West Indies such as Jamaica, Barbados and Bahamas, Hong Kong and in the tropical areas of the Americas[15,17,18] .
This plant is also currently cultivated in southwestern Nigeria [19]. AP can be stemmed in a variety of habitats, for instance; plains, hill slopes, wastelands, farms, dry or wetlands, seashores, and even roadsides, but it has a preferred tendency to grow in moist shady places, forests, and wastelands [15,17].
V. MORPHOLOGY OF ANDROGRAPHIS PANICULATA:

(Table No.1 Morphology of AP [20,21,22])

1.	**Plant height**	30–110 cm
2.	**Stem**	Dark green
	Length	30–100 cm
	Diameter	2–6 mm
	Shape	Quadrangular with longitudinal furrows and wings on the angles of the young parts, slightly enlarged at the nodes
3.	**Leaves**	Glabrous
	Length	2–12 cm
	Width	1–3 cm
	Arrangement	Lanceolate
	Shape	Pinnate, acute apex, entire margin
4.	**Flowers**	White with rose-purple spots on the petals
	Size	Small, in lax spreading axillary and terminal racemes or panicles
5.	**Seed**	Capsules linear-oblong, acute at both ends
	Size	1.9 cm × 0.3 cm
	Color	Yellowish brown
	Shape	Subquadrate, numerous
6.	**Flowering and fruiting**	December to April

VI. Pharmacological activity of Andrographis paniculata:
A. paniculata's aerial parts, roots, and entire plant have been used as traditional medicine in Asia for ages to cure a variety of diseases [7]. Stomachaches, inflammation, pyrexia, and intermittent fevers have all been treated with it by traditional medical practitioners[8].

The entire plant has been used to treat dyspepsia, influenza, diarrhoea, malaria, and respiratory infections, as well as as an antidote for snake bites and toxic stings from some insects.Infectious sickness, fever-causing diseases, colic pain, loss of appetite, irregular faeces, and diarrhoea are all treated with the leaf extract.A decoction of the aerial portions is used to treat the common cold, hypertension, diabetes, cancer, malaria, and snake bites in Malaysia[9,10,23].

Pharmacological activity:

Anti-inflammation–

i) LPS-induced NO production by suppressing iNOS.
ii) Complement 5a-induced macrophage recruitment via ERK1/2 and PI3K signal pathways.
iii) Binding of NF-κB oligonucleotide to nuclear proteins via _ERK1/2 or PI3/AKt signal pathway [23,24,25]**.**

Anti-cancer–

i) Proliferation of HL-60 cells, the JAK-STAT3 pathway.
ii) Tumor suppressor p53 expression, MAPKs (p38 kinase, JNK, ERK1/2) signaling pathway.
iii) oncogene v-Src protein expression and v-Src-induced transformation.
iv) Tumor in melanoma subcutaneously implanted mice (orally 200, 400 mg/kg BW, 10d) [26,27,28] .

Immunomodulation–

i)Proliferation and IL-2 induction in hPBL.
ii) antibody and the delayed-type hypersensitivity response (orally 1 mg/kg, 7d).
iii) NF-κB expression in lung and airway epithelial cells infiltration of inflammatory cells in lung, airway hyperreactivity (i.p. 2 μg/g BW, 7d).
iv) LPS induced dopaminergic neurodegeneration in primary rat mesencephalic neuron-glial cultures.
v) IL-2 production, proliferation, antibody production, T cell activation in EAE (i.p. 4 mg/kg BW).
vi) Symptom and immunological markers in patients with RA (30% andrographolide tablet, 14 weeks) [29,30,31] .

Anti-infection-

HIV induced cell cycle dysregulation, CD4+lymphocyte levels in HIV-1 infected individualsviricidal activity against HSV-1, EBV, via producing mature virus particle [32] .

Anti-hepatotoxicity-

i) CYP1A1 and CYP1A2 mRNA in mouse hepatocytes, synergistic effect in with a CYP1A1 inducer.
ii) Expression of the pi class of glutathione S-transferase [33,34] .

Anti-atherosclerosis-

I) HUVECs apoptosis via enhancement of PI3K-Akt activity.
ii) Thrombin-induced platelet aggregation via ERK1/2 pathway [25,35] .

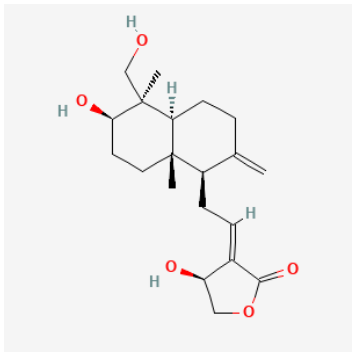
Anti-hyperglycemic effect-

i)Plasma glucose concentrations of STZ-diabetic rats(oral 1.5 mg/Kg).
ii) mRNA and protein levels of GLUT4 in soleus muscle [36,37] .

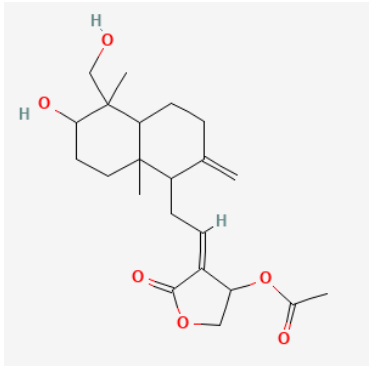
Anti-Oxidation-

i)MDA formation .
ii) GSH, SOD activity[38] .

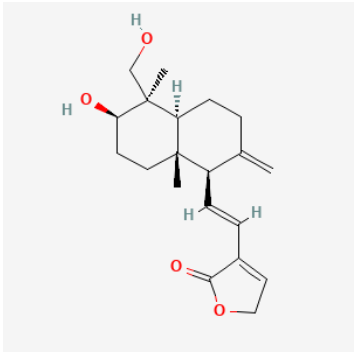
VII. Chemical constituents and their pharmacological action:



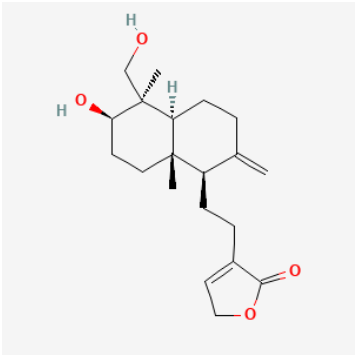
Andrographolide



14-acetylandrographolide



14-deoxy-11,12-didehydroandrographolide



14-Deoxyandrographolide

(Fig No.2: Chemical Structures [39])

Andrographolides have shown anticancer, bioactivities & hepatoprotective. It has also been reported to suppress IL-2 production and T-cell proliferation in a mixed lymphocyte reaction and to inhibit dendritic cell maturation and antigen presentation [40,41]. The other chemical constituent is 14-deoxyandrographolide which helps in the activation of NOS and guanylatecyclasevaso relaxation *in vitro* and *in vivo*, enhanced proliferation and interleukin-2 induction in human peripheral blood lymphocytes [25,42,43].

Neoandrographolide**:** NO, PGE2, iNOS and COX-2 in activated macrophages CCl4, tBHP-induced hepatotoxicity (*i.p*100 mg/kg, 3d)[38,44]. 14-deoxy-11,12-didehydroandrographolide: Muscle relexation, NO release from endothelial cells and anticancer[42,45]. 14-deoxy-14,15-didehydroandrographolide cytotoxic activity and cell cycle arrest of tumor cells NF-κB-dependent trans-activation.[40]

Andrograpanin protein kinase or p38 MAPKs pathways chemokine SDF-1α induced chemotaxis in Jurkat and THP-1 cells [35,46]. Isoandrographolide cell-differentiation-inducing activity proliferation of HL-60 cells [47,48]. 14-acetylandrographolide Growth of leukeamia, ovarian,renal cancer cells [49]. 19-*O*acetylanhydroandrographolide NF-κB-dependent trans-activation[46]. Kalmeghin Fever & cold[50]. Andrographiside Anti-oxidant, anti-lipoperoxidant, carcinogenic & detoxification[51,52].

VIII. Conclusion-

A.paniculata has been shown to have consistent hepatoprotective effects. Furthermore, its incorporation in effective herbal extracts formulations for liver illnesses that are resistant to current treatment adds to its potential efficacy. Apart from this A. paniculta exhibits properties like Anti-oxidant, Cardiovascular effect, Anti-inflammatory, and Anti-Hyperglycemic properties. Some phytochemicals found in medicinal plants have been shown to have significant anti-mutagenic, and anti-carcinogenic properties, and their potential for cancer treatment and prevention. Further studies related to anti-cancer activity is being investigate.

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