

AN OVERVIEW OF *ANDROGRAPHIS PANICULATA* (BURM. F.) NEES

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ABSTRACT

A lot of literature reviews about Andrographis paniculata has been published previously. Researchers are critically involved in the research to extract out the potential medicinal value which is present in this plant. It has a broad pharmacological value. The plant has many potential compounds but the major activities are because of the presence of few bioactive compound andrographolide and its different metabolites. The extremely bitter taste of the plant is due the presence of this compound. From the review of the literature on this plant we found that this plant has antioxidant, hepatoprotective, antimicrobial, anticancer, antivenom, anti HIV, antimalarial, antipyretic, antifertility, antidiarrhoeal, antidiabetic, antihyperlipidemic activities.

Keywords: *Andrographis paniculata*; pharmacological activities; bioactive molecules.

INTRODUCTION

Nature has been a source of medicinal agents for thousands of years and since the beginning of mankind. Medicinal plant is an integral part of human life to combat the sufferings from the dawn of civilization. It is estimated that more than 80,000 of total plant species have been identified and used as medicinal plants around the world.^[1] Over the past twenty years, interest in medicinal plants has grown enormously from the use of herbal products as natural cosmetics and for self-medication by the general public to the scientific investigations of plants for their biological effects in human beings.^[2] Therefore, people are encouraging indigenous production and processing of these medicinal plants to use in different cultures and religion for the treatment of

various diseases.^[3] The demand for plant based medicines, health products, pharmaceuticals, food supplement, cosmetics etc are increasing in both developing and developed countries, due to the growing recognition that the natural products are non-toxic, have less side effects and easily available at affordable prices^[4]. Now a days, there is a revival of interest with herbal-based medicine due to the increasing realization of the health hazards associated with the indiscriminate use of modern medicine and the herbal drug industries is now very fast growing sector in the international market^[5]. There is great demand for herbal medicine in the developed as well as developing countries like India, because of their wide biological activities, higher safety of margin than



Andrographis paniculata leaves

the synthetic drugs and lesser costs^[6,7] *Andrographis paniculata* (Burm. f.) Nees (Acanthaceae) is a plant that has been effectively used in traditional Asian medicines for centuries. It's perceived "blood purifying" property results in its use in diseases where blood "abnormalities" are considered causes of disease, such as skin eruptions, boils, scabies, and chronic undetermined fevers. The aerial part of the plant, used medicinally, contains a large number of chemical constituents, mainly lactones, diterpenoids, diterpene glycosides, flavonoids, and flavonoid glycosides. Controlled clinical trials report its safe and effective use for reducing symptoms of uncomplicated upper respiratory tract infections. Since many of the disease conditions commonly treated with *Andrographis paniculata* in traditional medical systems are considered self-limiting, its purported benefits need critical evaluation^[8]. *Andrographis paniculata* grows widely in many Asian countries, such as China, India, Thailand and Sri Lanka and has a long history of therapeutic usage in Indian and Oriental medicine. The herb is official in Indian Pharmacopoeia as a predominant constituent of at least 26 Ayurvedic formulations used to treat liver disorders. It is one of the herbs, which can be used to treat neoplasm as mentioned in ancient Ayurvedic literature. *A. paniculata* is reported as a cold property herb in

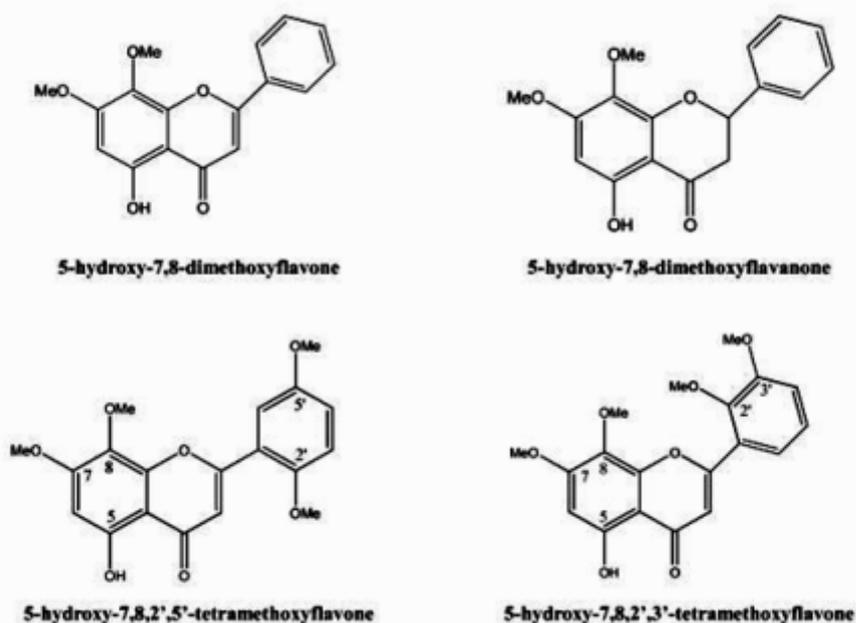
Traditional Chinese medicine (TCM) and is used to get rid of body heat and to expel toxins.

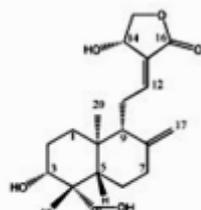
ETHNOBOTANICAL USES

Ethnobotanically, the leaves and roots of *A. paniculata* have been used since centuries in Asia and Europe to cure the wide spectrum of health ailments. However, the whole plant is also used for certain limited purposes. Due to its "cold property" activity, it is recommended to be used to get rid of the body heat in fevers and to dispel toxins from the body. The plants are also recommended for the use in cases of leprosy, gonorrhoea, scabies, boils, skin eruptions, and chronic and seasonal fever for its high "blood purifying" properties^[7]. The overall traditional uses of AP in different traditional medicinal systems (TMS) or countries are pointed out in Table 3. In addition, it is also widely used for medicinal purposes by the traditional practitioners, tribes, or community as a folklore remedies in different countries^[8]. Few chemical compounds^[9] isolated and characterized from the plant are as follows.

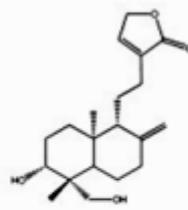
PHARMACOLOGICAL ACTIVITY

Research studies conducted in past decades have confirmed that *Andrographis*, if properly administered, has a surprisingly broad range of pharmacological effects. Some of them are extremely beneficial as follows.

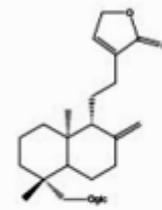




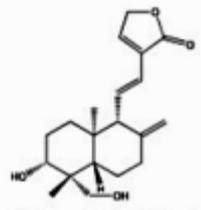
andrographolide



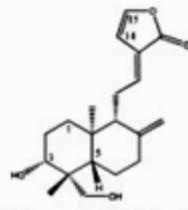
14-deoxyandrographolide



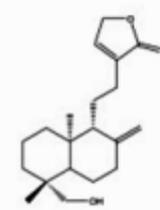
neoandrographolide



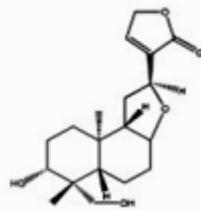
14-deoxy-11,12-didehydroandrographolide



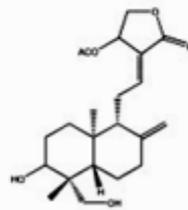
14-deoxy-14,15-didehydroandrographolide



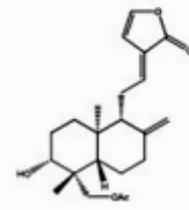
andrograpanin



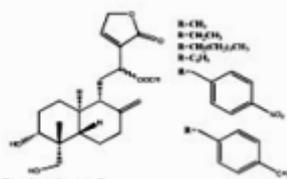
isoandrographolide



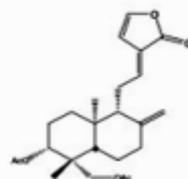
14-acetylandrographolide



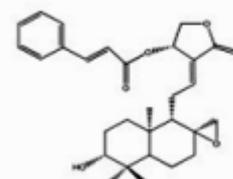
19-O-acetylanhydroandrographolide



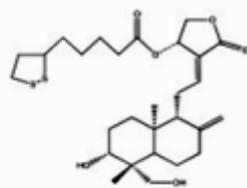
Derivatives of 12-hydroxy-14-dehydroandrographolide



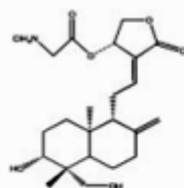
3,19-O-diacetylanhydroandrographolide



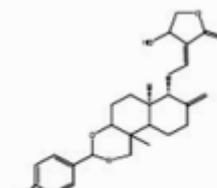
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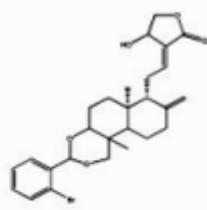
14-Alpha-lipoyl andrographolide



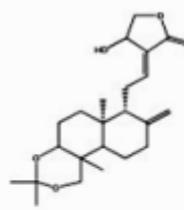
14-Glycyl andrographolide hydrochloride



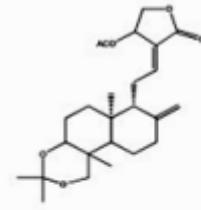
SRJ23



SRJ09



3,19-isopropylideneandrographolide



14-acetyl-3,19-isopropylideneandrographolide

Hepatoprotective activity

Only few studies on the crude extracts of *A. paniculata* on liver function are available. Administration of the extract to normal adult rats in single and multiple doses for seven and 15 consecutive days did not significantly affect serum transaminases^[8]. A comparative study on the effect of leaf extract or andrographolide on carbontetrachloride (CCl₄)-induced hepatic microsomal lipid peroxidation revealed a protective effect of a single oral dose of the extract and of andro-grapholide. However, high concentration CCl₄-induced microsomal lipid peroxidation *in vitro* was completely protected by the extract but not by andrographolide, indicating that the hepatoprotective effect is not solely due to the presence of andrographolide^[9].

Immunostimulatory activity

Intragastric administration of an ethanol extract of the aerial parts (25mg/kg body weight) or purified andrographolides (1mg/kg body weight) to mice stimulated antibody production and the delayed-type hypersensitivity response to sheep red blood cells^[10]. The extract also stimulated a non-specific immune response in mice, measured by macrophage migration index, phagocytosis of [14C] leucine-labelled *E. coli*, and proliferation of splenic lymphocytes^[11]. The extract was more effective than either andrographolide or neoandrographolide alone, suggesting that other constituents may be involved in the immunostimulant response^[12].

Antidiabetic activity

Antidiabetic property of *A. paniculata* was confirmed by Borhanuddin *et al.* and Husen *et al.* in aqueous extract^[13-14] and by Zhang *et al.* in ethanolic extract^[15]. Along with antihyperglycaemic property, the ethanolic extract may also reduce oxidative stress in diabetic rats as studied by Zhang *et al.*^[16]. Further, it was concluded by Yu BC *et al.* that the andrographolide was responsible for the antihyperglycemic activity^[17]. Finally, the antidiabetic potential of *A. paniculata* was found to restore impaired estrous cycle in alloxan induced diabetic rats^[18].

Hypotensive activity

Andrographis paniculata is reported to have, by acting through β -adrenoceptors, autonomic ganglion receptor and angiotensin converting

enzyme (ACE) inhibitory activity^[19]. The plant possesses a remarkable capability to challenge the norepinephrine induced contractions resulting in vaso relaxation in isolated rat^[20].

Anti-inflammatory activity

A. paniculata can also inhibit the production of inflammatory mediators and alleviate acute hazards at its optimal dosages^[21]. Shen *et al.* observed that the andrographolide, an active component of *A. paniculata*, inhibits inflammatory responses by rat Neutrophils^[22].

Antibacterial activity

An ethanol extract of the leaves inhibited the growth *in vitro* of *Escherichia coli* and *Staphylococcus aureus*. A 50% methanol extract of the leaves inhibited growth *in vitro* of *Proteus vulgaris*^[23]. However, no *in vitro* antibacterial activity was observed when dried powder from the aerial parts was tested against *E. coli*, *Staphylococcus aureus*, *Salmonellatyphi* or *Shigella species*^[24].

Antimalarial activity

A 50% ethanol extract of the aerial parts inhibited the growth of *Plasmodium berghei* both *in vitro* (100 mg/ml) and in mice after intragastric administration (1 g/kg body weight)^[25].

Intragastric administration of a 1-butanol, chloroform or ethanol-water extract of the aerial parts to *Mastomys natalensis* inhibited the growth of *P. berghei* at doses of 1–2g/kg body weight. Andrographolide (5 mg/kg body weight) and neoandrographolide (2.5mg/kg body weight) were also effective when administered by gastric lavage^[26].

Cardiovascular Effects

Aqueous extract of *A. paniculata* produced a dose-dependent fall in systolic blood pressure of both spontaneously hypertensive rats (SHRs) and normotensive Wistar-Kyoto rats, with a corresponding significantly decrease in plasma angiotensin converting enzyme (ACE) activity^[27]. The hypotensive effect of n-butanol and aqueous fractions of the crude water extract is antagonized or attenuated by phentolamine, hexamethonium, pyrilamine, and cimetidine, but not by propranolol, atropine, or captopril^[28].

Effects on Reproductive Systems

A number of animal studies report an effect of *Andrographis paniculata* on male and female

reproduction. Early reports of oral administration of powdered stem indicated an antifertility effect in male Wistar mice, but no impact on fertility in female mice. It has also been reported that administration of *Andrographis paniculata* resulted in abortion in pregnant rabbits. Intraperitoneally injection of the decoction of aerial parts to female albino mice was reported to prevent implantation and caused abortion at different gestation periods^[29].

Cytotoxic Activity

Hydro-alcoholic extract of *A. paniculata* was examined by Singh RP *et al.* to indicate the chemopreventive potential of *A. paniculata* against chemotoxicity including carcinogenicity on drug metabolizing enzymes^[30].

Anti- HIV Activity

Aqueous extracts of the leaves inhibited HIV-1 infection and replication in the lymphoid cell line MOLT-4[64]. A hot aqueous extract of the aerial parts reduced the percentage of HIV antigen-positive H9 cells^[31]. Dehydro and rographolide inhibited HIV-1 and HIV-1 (UCD123) infection of H9 cells at 1.6mg/ml and 50mg/ml respectively and also inhibited HIV-1 infection of human lymphocytes at 50mg/ml^[32]. A methanol extract of the leaves suppressed syncytia formation in co-cultures of uninfected and HIV-1 infected MOLT cells (median effective dose [ED50] 70mg/ml)^[33].

CONCLUSION

The demand of *A. paniculata* (AP) is greatly increased in the past few years for its overwhelming therapeutic potentials. Available data on AP also clearly expresses a broad spectrum of pharmacological properties of this plant. Due to possessing extensive pharmacological activities, the AP can be safely regarded as one of the modern catholicons. However, the investigated pharmacological activities of AP need validation through the clinical study. Though several clinical studies were successfully completed without adverse effects or fatalities, most of them only investigated upper respiratory tract infections for a variety of conditions. Verification of the efficacy of other biological activities of AP including antidiabetic, anticancer, anti-inflammatory, and

hepato- protective activities, on human study subjects would bring a lot of benefits for the largest population of the globe. We assume that the AP could be useful as highly applied the therapeutic agent for a variety of disorders in the near future to cure human diseases as well as some animal diseases. Pharmacological and phytochemical studies are needed to find new bioactive compounds followed by efforts towards conservation of this plant.

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