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RESEARCH ARTICLE

A BRIEF OVERVIEW ON *Andrographis paniculata* (Burm. f) Nees., A HIGH VALUED MEDICINAL PLANT: BOON OVER SYNTHETIC DRUGS

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Since time immemorial the medicinal plants, as sources of remedies, are widely used as alternative therapeutic tool for the treatment of plethora of acute and chronic diseases ranging from common cold to complex human diseases all over the world. Following the advent of modern medicine, herbal medicine suffered a set back, but due to the multiple drug resistance, side effects associated with antibiotics, restriction in use of synthetic antioxidant drugs because of its carcinogenicity and limited availability of anticancer drugs has forced the scientist to search for new alternative substances from plant origin. *A. paniculata* is in demand in terms of its high valued medicinal properties. Extensive research on this plant considered it as a good source of medicinal herb over the commercially available synthetic drugs. It can be used for pharmaceutical applications, food preservation and also as a food supplement, in order to promote growth of live stock and to increase the nutritional value of different foods and diet.

Key Words: Medicinal plant, Herbal medicine, *Andrographis paniculata*, Synthetic drugs.

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INTRODUCTION

The use of plants and plant products as medicines could be traced as far back as the beginning of human civilization (Rastogi and Mehrotra, 2002). They are considered as the backbone of traditional medicine and are widely used to treat a plethora of acute and chronic diseases ranging from the common cold to complex human diseases all over the world (Mazumdar and Rahman, 2008). India is one of the world's twelve leading biodiversity centers with the presence of over 45,000 different plant species, out of this about 15,000-20,000 plants have good medicinal properties of which only about 7,000-7,500 are being used by traditional practitioners. The Siddha system of medicine uses around 600, Ayurveda 700, Unani 700 and modern medicine about 30 plants species, Chaudhri (1996). An estimate of WHO demonstrates about 80% of world population depends on natural products for their health care, because of side effects and high cost of modern medicine, Satakopan (1994). 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, Kalia (2005). 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 (Sharma *et al.*, 2008). 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 the synthetic drugs and lesser costs (Gadre *et al.*, 2001; Sharma *et al.*, 2008).

Andrographis paniculata (Burm.f) Nees

An herb is a plant or plant part used for its scent, flavor, or therapeutic properties, and medicinal products made from them are frequently taken to improve health as dietary supplements (Kanokwan and Nobuo, 2008). *Andrographis paniculata* (Burm. f) Nees., also called as Kalmegh or "King of Bitters" belongs to the family *Acanthaceae* (Mishra *et al.*, 2007) is a herbaceous plant (Kanokwan and Nobuo, 2008). Mostly leaves and roots have been traditionally used over centuries for different

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medicinal purposes in Asia and Europe as a folklore remedy for a wide spectrum of ailments or as a herbal supplement for health promotion (Kanokwan and Nobuo, 2008).

Synonyms

Arab: Quasabhuva; Assamese: Chirota, Kalmegh; Bengali: Kalmegh; English: The Creat, King of Bitters; Gujrati: Kariyatu; Hindi: Kirayat; Japan: Senshinren; Kannada: Nelaberu; Malayam: Kiriyattu; Malaysia: Hemptedubumi, Sambiloto; Marathi: Oli-kiryata; Oriya: Bhuinimba; Persian: Naine-havandi; Sanskrit: Kalmegha, Bhuinimba; Scandinavian: Green Chiretta; Tamil: Nilavembu; Telugu: Nilavembu (Mishra *et al.*, 2007; Kanokwan and Nobuo, 2008). Traditional Chinese Medicine (TCM): Chuan-Xin-Lian; Chunlianqialio; Yiqianxi; Si-Fang-Lian and Zhanshejian. Traditional Indian Medicine: Kalmegh; Kiriyato; Maha-tikta and Bhunimba. Traditional Thai Medicine: Fah Tha Lai and Nam Rai Pangpond (Kanokwan and Nobuo, 2008).

Taxonomical Classification

<i>Kingdom</i>	: Plantae, Plants;
<i>Sub Kingdom</i>	: Tracheobionta, Vascular plants;
<i>Super Division</i>	: Spermatophyta, Seed plants;
<i>Division</i>	: Angiosperma
<i>Class</i>	: Dicotyledonae
<i>Sub class</i>	: Gamopetalae
<i>Series</i>	: Bicarpellatae
<i>Order</i>	: Personales
<i>Tribe</i>	: Justiceae
<i>Family</i>	: Acanthaceae
<i>Genus</i>	: <i>Andrographis</i>
<i>Species</i>	: <i>A. paniculata</i> (Burm. f) Nees (Mishra <i>et al.</i> , 2007)

Habitat

It grows abundantly in southeastern Asia, *i.e.*, India, Sri Lanka, Pakistan, Java, Malaysia and Indonesia but it is cultivated extensively in India, China and Thailand, the East and West Indies, and Mauritius (Mishra *et al.*, 2007; Kanokwan and Nobuo, 2008). *Andrographis paniculata* is normally grown from seeds ubiquitously in the native areas where it grows in pine, evergreen and deciduous forest areas, and roads and in villages. In India, it is cultivated during rainy phase of summer season (kharif crop). Any soil having fair amount of organic matter is suitable for commercial cultivation of this crop (Mishra *et al.*, 2007).

Morphology

It 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 short petiole. Inflorescence of the plant is characterized as patent, terminal and axillary in panicle, 10-30 mm long; bract small; pedicel short. The flowers possess botanical features of calyx 5-particled, small, linear; corolla tube narrow, about 6 mm long; limb longer than the tube, bilabiate; upper lip oblong, white with yellowish top; lower lip broadly connate, 3-lobed, white with violet markings; stamens 2, inserted in the throat and far exerted; anther basally beared. Superior ovary, 2-celled; style far exerted. 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, thinly glandular-hairy. Seeds are very small, sub quadrate (Medicinal plants in Viet Nam. Manila, 1990; Standard of ASEAN herbal medicine, 1993; Thai herbal pharmacopoeia, 1995; Pharmacopoeia of the People's Republic of China, 1997; Mishra *et al.*, 2007) (Figure 1).

Demand

A. paniculata is in demand in terms of its medicinal properties. 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 (Mishra *et al.*, 2007). The *Indian Pharmacopoeia* narrates that it is a predominant constituent of at least 26 Ayurvedic formulations (Zhang, 2004; Mishra *et al.*, 2007; Kanokwan and Nobuo, 2008). In Traditional Chinese Medicine, it is an important "cold property" herb used to get rid the body heat, as in fevers, and to dispel toxins of the body (Deng, 1978; Kanokwan and Nobuo, 2008). In Scandinavian countries, it is commonly used to prevent and treat common cold (Caceres *et al.*, 1997; Kanokwan and Nobuo, 2008). In Thailand, this plant was selected by the Ministry of Public Health as one of the medicinal plants to be included in "The National List of Essential Drugs A.D. 1999" (List of Herbal Medicinal Products) (Pholphana *et al.*, 2004; Kanokwan and Nobuo, 2008; Katakya and Handique, 2010b).

Commercial importance and market potential

The market potential of *A. paniculata* is very high (Sharma *et al.*, 2008), it is highly consumed as stomachic (Agrawal *et al.*, 2005), hepatoprotective (Agrawal *et al.*, 2005), dyspepsia (Agrawal *et al.*, 2005), anthelmintic (Agrawal *et al.*, 2005), bitter tonic, Kandy (2005), febrifuge, Kandy (2005). With reference to trade an

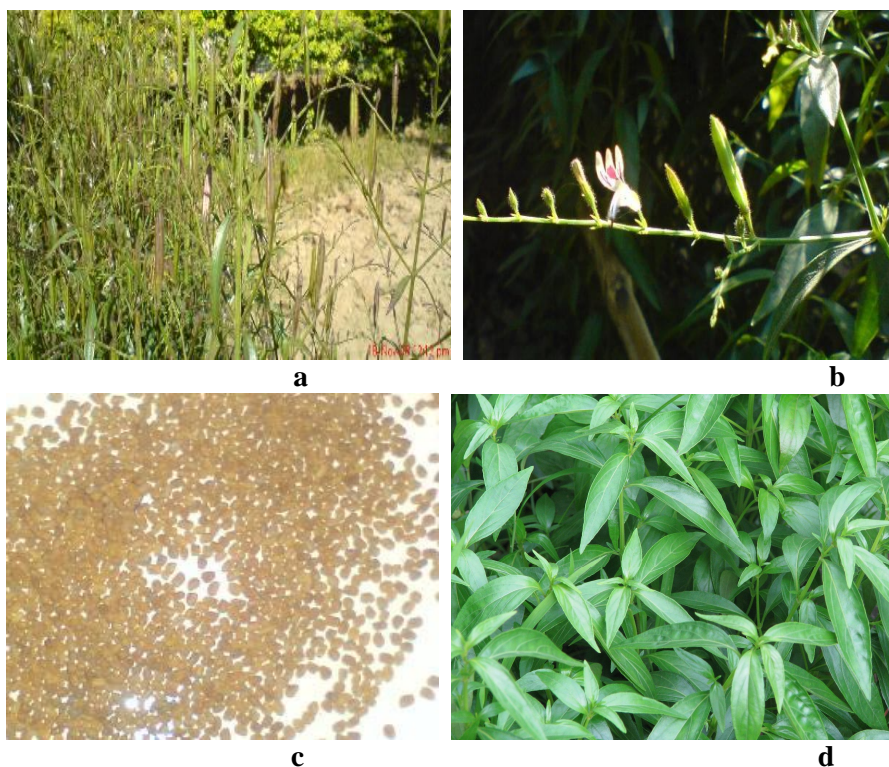


Fig. 1. Morphology of *Andrographis paniculata* showing **a)** Aerial parts with mature and immature capsules; **b)** flower buds to flowering to capsule formation; **c)** matured seeds; **d)** leaves.

estimated consumption of *Andrographis paniculata* aerial parts is 250 tones (Sharma *et al.*, 2008). Important, biologically active plant metabolites isolated from various parts of this plant are andrographolide, 14-deoxy-11-oxoandrographolide, 14-deoxy-11, 12 didehydroandrographolide and neoandrographolide (Balmain and Connolly, 1973). The other important compounds isolated from different parts of *A. paniculata* are apigenin-7, 40-di-omethyl ether, carvacrol, eugenol, myristic acid, hentriacontane, tritriacontane, oroxylon A and wogonin (Rastogi and Mehrotra, 1993). The high demand for andrographolide by the pharmaceutical industries is largely met by extraction of the compound from wild populations; however, the commercial exploitation of this compound is hampered due to its limited availability (Kanjilal *et al.*, 2002). The heavy demand of andrographolide in Indian as well as international markets has motivated Indian farmers to start commercial cultivation of this medicinal plant (Kanjilal *et al.*, 2002; Katak and Handique, 2010a).

Conventional method vs. Micropropagation

Conventional propagation of this species is limited to vegetative means, which is difficult and slow in meeting the commercial quantities required (Martin, 2004; Purkayastha *et al.*, 2008, Katak and Handique, 2010a). Variability among the seed-derived progenies and scanty and delayed rooting of seedlings curbs its propagation via seeds (Martin, 2004; Purkayastha *et al.*, 2008, Katak and Handique, 2010a). Micropropagation is the proven method for efficient *in vitro* propagation of medicinal and aromatic plants and for commercial exploitation of valuable plant-derived pharmaceuticals (Bajaj *et al.*, 1988; Purohit *et al.*, 1994; Pattnaik and Chand, 1996; Rout, 2002; Faisal *et al.*, 2005; Purkayastha *et al.*, 2008, Katak and Handique, 2010a). Information on medicinal uses and preliminary tissue culture studies are reported by Prathanturug *et al.*, 1996; Martin, 2004; Natarajan *et al.*, 2006; Purkayastha *et al.*, 2008; Katak and Handique, 2010a.

Pharmacological attributes

Researches 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:-

Abortifacient: can abort pregnancy.

Acrid (hot): in this case, slightly rubifacient to the skin.

Analgesic: pain killer.

Antibacterial: fights bacterial activity.

Antidiarrhoeal and intestinal effects: effective against bacterial dysentery and diarrhea.

Anti-inflammatory activity: *Andrographis paniculata* is also used as a folk medicine for fever, pain reduction and disorders of the intestinal tract.

Antimalarial activity: *Andrographis paniculata* is found to considerably inhibit the multiplication of *Plasmodium berghei*.

Antioxidant activity: fight against free radicals.

Antipyretic: fever reducer.

Antisnakevenom: fight against snake venom.

Antithrombotic: blood clot prevention.

Antiviral: inhibits viral activity.

Cancerolytic: fights, even kills cancer cells.

Cardiovascular activity: effective against heart disease.

Choleretic: alters the properties and flow of bile.

Depurative: cleans and purifies the system, particularly the blood.

Expectorant: promotes mucus discharge from the respiratory system.

Hypoglycemic activity: prevent hypoglycemia.

Hepatoprotective activity: In Ayurvedic medicine, there are 26 different remedies containing *Andrographis paniculata* used to treat liver disorders.

Immunological potential: increases white cell phagocytosis, inhibits HIV-I replication and improves CD4⁺ and T-lymphocytes counts.

Laxative: aids bowel elimination.

Psycho-pharmacological activity: potent central nervous system (CNS) depressant action.

Sedative: relaxing herb, though not with the same effect as the accepted herbal sedatives, valerian root, hops, skullcap, etc.

Thrombolytic: blood clot buster.

Vermicidal: kills intestinal worms (Mishra *et al.*, 2007; Kanokwan and Nobuo, 2008).

Phytochemical attributes

The characteristic secondary metabolites encountered in the plant have considerably enhanced its importance in the arena of medicinal plants and medicines. It is specifically rated very high in therapeutic action in curing liver disorders and common cough and cold in humans. A number of diterpenoids and diterpenoid glycosides of similar carbon skeleton have been isolated

from *Andrographis*, mainly the most bitter compounds among them are andrographolide, neoandrographolide, deoxyandrographolide. The aerial parts of the plant (leaves and stem) are used to extract the active phytochemicals (Mishra *et al.*, 2007). Previous investigations on the chemical composition of *Andrographis paniculata* showed that it is a rich source of diterpenoids and 2'-oxygenated flavonoids including andrographolide, neoandrographolide, 14-deoxy-11,12-didehydroandrographolide, 14-deoxyandrographolide, isoandrographolide and 14-deoxyandrographolide 19 β -D-glucoside, homoandrographolide, andrographan, andrographosterin, stigmaterol (Pholphana *et al.*, 2004; Chen and Liang, 1982; Pramanick *et al.*, 2006; Kanokwan and Nobuo, 2008) andrographiside, deoxyandrographiside, homoandrographolide, andrographan, andrographon, andro-graphosterin (Mishra *et al.*, 2007). The bioactive compound of the medicinal plant *Andrographis paniculata* is andrographolide. Andrographolide has highly bitter taste, is colorless crystalline in appearance, and possess a "lactone function" (Mishra *et al.*, 2007). The leaves of *Andrographis* contain the highest amount of andrographolide (2.39%), the most medicinally active phytochemical in the plant, while the seeds contain the lowest (Sharma *et al.*, 1992). The molecular formula of andrographolide is C₂₀H₃₀O₅, while its molecular structure is shown in Figure 2. Andrographolide can be easily dissolved in methanol, ethanol, pyridine, acetic acid and acetone, but slightly dissolved in ether and water.

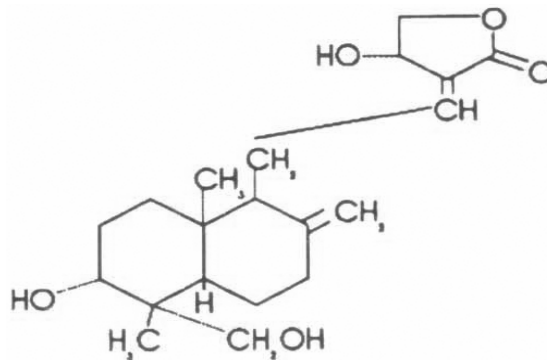


Fig. 2. Molecular structure of Andrographolide

The melting point of this compound is 228°C – 230°C and the ultraviolet spectrum in ethanol, λ_{max} is 223nm. The analysis of andrographolide can be done by thin layer chromatography (TLC) (Rajani *et al.*, 2000), high performance liquid chromatography (HPLC) (Wongkittipong *et al.*, 2000; Rajani *et al.*, 2000) and crystallisation (Rajani *et al.*, 2000). Growing region and

seasonal changes have a strong impact on formation of the diterpene lactones. The highest concentration of the active components is found just before the plant blooms, making early fall the best time to harvest (Sharma *et al.*, 1992; Mishra *et al.*, 2007).

On the basis of presented results, we can consider *Andrographis paniculata* as a good source of medicinal herb over the synthetic drugs. This study could be beneficial for the development of herbal extracts for pharmaceutical application or food supplements or food preservation in order to promote growth of live stock and to increase the nutritional value of different foods and diet.

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