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Pharmacological activities of *Andrographis paniculata*, *Allium sativum* and *Adhatoda vasica*

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Key words: *Andrographis paniculata*, *Allium sativum*, *Adhatoda vasica.*

Abstract

Andrographis paniculata, *Allium sativum* and *Adhatoda vasica* are the three important medicinal plants in which it is used for daily consumption by the user especially in the rural areas. Not only rural people are seeking for the medical benefits from the medicinal plants but also urban people because trying to eliminate the side effects of synthetic medicine on health. Research using these three plants should not stop here and must be extensively employed by the researchers and try to get more medical properties which is useful for the public. Andrographolide from *Andrographis paniculata* is the active component obtained from the aerial parts of this plant, having very bitter taste. It is a bicyclic diterpenoid lactone with multiple pharmacological activities. In 1997, garlic (*Allium sativum)* was the most widely used natural supplement in US house-holds. Garlic was shown to be used more than twice as much as any other natural supplement. Extract of *Adhatoda vasica* leaves has been used for the treatment of various diseases and disorders in Ayurved and Unani medicine. The plant has been used in the indigenous system of medicine in India for more than 2000 years. Compounds which are present in the plant/s which when consumed it promote the health of the consumers although some studies suggest that consumption may lead to toxic effect but in general it is safe to consume moderately. In many literature survey, researchers are trying the best to overcome the bacterial resistance by isolating compounds from the medicinal plants (one of the method) due to the resistance of bacterias towards synthetic chemicals. Overally this proved the importance of the medicinal plants.

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Introduction

Andrographis paniculata

Traditional medicine is made available via ancient, natural health care practices such as tribal lore, home herbal remedy, and the *Baidhya*, *Ayurveda* and *Amchi* (traditional healing system of Tibet and mountain areas of Nepal) systems (Kunwar *et al*., 2010). Current estimates suggest that, in many developing countries, about two thirds of the population relies heavily on traditional practitioners and medicinal plants to meet primary health care needs. Although modern medicine may be available in these countries, traditional herbal medicine is often been used for historical, cultural, and ecological reasons, in particular this is due to continued availability, better compatibility and high acceptance (Kunwar *et al*., 2010).

Standardization of ayurvedic drug and plant materials is the need of the day. Several pharmacopoeias containing monographs on plant material describes only the physico-chemical parameter. *Andrographis peniculata* Nees (Acanthaceae), commonly known as kalmegh, is widely used in the traditional system of Indian medicine in the treatment of hepatitis. The drug is mainly for its diterpenoid andrographolide and related compound (Jadhao, 2010).

Andrographis paniculata is one such important plant, which has its traditional use in Ayurvedic (Indian), Thailand and Chinese medicine, owing to the geographical distribution of the plant. Andrographolide is the active component obtained from the aerial parts of this plant, having very bitter taste. It is a bicyclic diterpenoid lactone with multiple pharmacological activities (Maiti *et al*., 2006). According to a researchers from India, they mentioned that most the biological activities of *Andrographis paniculata* is due to its bioactive compound known as Andrographolide (Sudhakaran, 2012; Bhattacharya *et al*., 2012; Dandin and Murthy, 2012; Rajpar *et al*., 2011; Sivananthan and Elamaran, 2013).

Bitterness from this plant is related with its various pharmacological properties such as antibiotic, antiviral, antimicrobial, antiinflammatory, antivenom and immunostimmulatory, anticancer, anti-HIV, anti-allergic, and hypoglycemic activity (Jegathambigai *et al*., 2010; Sivananthan and Elamaran, 2013). Also used for treating common cold, upper respiratory tract infection, tonsillitis, pharyngitis, laryngitis, pneumonia, tuberculosis, pyelonephritis, hepatic impairment (Maiti *et al*., 2006). Can be utilize as antioxidant (Dandin and Murthy, 2012). Also can be used as antityphoid and antimalarial since the whole plant is having medicinal value especially leaves which are in fresh and dried condition which are extensively included in the Asian traditional medicine for treating illness (Rajpar *et al*., 2011). Also can be employed as a treatment for syphilitic cachexia and syphilitic ulcers (Martin, 2004).

Andrographis paniculata has been employed historically in epidemics, including the global flu epidemic of 1919. This pandemic is recognized as the most fatal infectious disease outbreak in human history and even more virulent than the Black Death of the fourteenth century, and *Andrographis paniculata* was credited during that period as a wonder drug for arresting the spread of the contagious illness as no country escaped its attack unless India (Alireza *et al*., 2011).

Apart from kalmegh, there are different names available for *Andrographis paniculata*. Nain-e Havandi (Persian), Chuan Xin Lian (Chinese), The Creat, King of Bitters (English), Nilavembu (Tamil and Telugu), Andrografis (Spanish and Russian), Sambiloto (Indonesian), Hempedu bumi (Malay), Senshinren (Japanese) (Alireza *et al*., 2011). It is also known as Maha-tita or bhui-neem because of its similarity in appearance and bitter taste as that of neem (*Azadirachta indica* A. Juss) although this plant is smaller in the size (Bhattacharya *et al*., 2012).

It is believed that the most probable reason for naming the plant as *Andrographis paniculata* is the presence of a diterpene lactone in the leaves namely andrographolide and also the existence of two flavones viz, andrographin and panicolin in the roots. Regardless of the above mentioned case, the botanical name of the plant consisted of *Andrographis* and *paniculata* carrying other meanings as well. Andro is a place name in India. In fact, Andro is a town in Imphal East district, Manipur state, North East of India. Andro also is a prefix in the Greek language meaning “male” or “masculine” can refer to a number of things. *Graphis* is a genus of lichens from the family Graphidaceae and in the Latin language means pencil, paintbrush or writing style, and *paniculata* performs a Latin pronunciation of paniculate or panicle, which refers to the inflorescence of the plant (Alireza *et al*., 2011).

Andrographis paniculata is an erect branched annual herb of height 0.3–0.9 m, with branches sharply quadrangular, leaves lanceolate, flowers small, white, solitary with yellowish brown seeds (Chiramel *et al*., 2006). Even though *Andrographis paniculata* is known as a hermaphroditic, self-compatible and a habitual inbreeding plant, there is an assumed rate of 28% cross pollination for it. Inflorescence pattern extends axillary with terminal panicle or raceme. *Andrographis paniculata* has a fibrous or adventitious root system (Alireza *et al*., 2011). This plant grows on a wide variety of habitats such as mountain slopes, rangelands, wetlands, seashores and even on roadside (Rajpar *et al*., 2011). It grows abundantly in tropical climatic conditions, that is, moist and sunny situations in any soil having reasonable amount of organic material (Talei *et al*., 2013).

Apart from andrographolide, *Andrographis paniculata* plant also having compound which are having some pharmacological activities like Neoandrographolide which has also shown activity against malaria (Rajpar *et al*., 2011). In a research conducted by few researchers, they found that both the accessions of *Andrographis paniculata*, viz. 11261 and 11265 exhibited good potential to withstand to salt water environment and produce considerably high amount of medicinally important phytochemicals, viz. Andrographolide (AG), Neoandrographolide (NAG) and 14-deoxy-11, 12-didehydroandrographolide (DDAG) (Rajpar *et al*., 2011).

Allium sativum

A member of the Liliaceae family, garlic (*Allium sativum*) is a cultivated food highly regarded throughout the world. Originally from Central Asia, garlic is one of the earliest of cultivated plants. The Ebers Codex, and Egyptian medical papyrus dating to about 1550 B.C.E. mentions garlic as an effective remedy for a variety of ailments. Early men of medicine such as Hippocrates, Pliny and Aristotle espoused a number of therapeutic uses for this botanical (Bongiorno *et al*., 2008). Almost 25 centuries ago, Hippocrates, the Father of Medicine, stated "let food be thy medicine and let medicine be thy food". Supporting this statement, Hippocrates prescribed garlic for a variety of conditions. Garlic was given as perhaps one of the earliest "performance enhancing" agents to the original Olympic athletes in Greece (Bhandari, 2012).

The region with the largest commercial garlic production is central California. China is also a supplier of commercial garlic. In 1997, garlic was the most widely used natural supplement in US households. Garlic was shown to be used more than twice as much as any other natural supplement. It is also known as Allii Sativi Bulbus, Knoblauch, Ail, Ajo, Allium, Camphor of the Poor, Garlic Clove, Nectar of the Gods, Poor Man’s Treacle, Rust Treacle, Stinking Rose (Bathaei and Akhondzadeh, 2008).

In a separate literature, the researcher had mentioned that the garlic was given different names that are still in use such as Russian penicillin, natural antibiotic,

vegetable viagra, plant talisman, rustic's theriac, snake grass (Bhandari, 2012).

The recommended daily doses of garlic is 4 g of fresh garlic, approximately 1 clove (4–12 mg of allicin or 2–5 mg of allicin), dehydrated garlic powder, 600–1200 mg in divided dose, AGE, 1–7.2 g/day, fresh air dried bulb, 2–5 g, garlic oil, 2–5 mg, dried bulb, 2–4 g three times daily, tincture (1:5 in 45% alcohol), 2–4 mL three times daily (Bathaei and Akhondzadeh, 2008). Garlic bulb approximately 65% water, 28% carbohydrates (mainly fructans), 2.3% organosulfur compounds, 2% protein (mainly allinase), 1.2% amino acids (mainly Arginine), and 1.5% fiber (Ranjini and Raju, 2012).

The name *Allium sativum* is derived from the Celtic word "all", meaning burning or stinging, and the Latin "sativum" meaning planted or cultivated. The English word, garlic, is derived from the Anglo-Saxon "gar-leac" or spear plant, referring to its flowering stalk. Garlic contains at least 33 sulphur compounds, several enzymes, 17 amino acids, and minerals such as selenium. Of all the *Allium* species, garlic contains a higher concentration of sulphur compounds. Garlic's pungent odour and many of its medicinal effects are due to the sulphur compounds. Approximately 1% alliin (S-allyl cysteine sulfoxide) is present in dried, powdered garlic. Allicin (diallyl thiosulfinate or diallyl disulfide), which is the most biologically active compound in garlic, does not exist until garlic is crushed or cut. Enzyme allinase, which is activated upon injuring the garlic bulb, metabolises alliin to allicin. Allicin is subsequently metabolised to vinyldithiines. This process requires hours at room temperature and minutes during cooking. Allicin, which has antimicrobial effects against many viruses, bacteria, fungi and parasites, was first chemically isolated in the 1940's (Bhandari, 2012). Also contain compound known as Ajoene which has anticancer properties. Apart from compounds mentioned above, *Allium sativum* contains flavonoids, Vitamin A, vitamin B1 and vitamin C, potassium, phosphorous, selenium, magnesium, calcium, sodium, germanium, manganese, iron, and trace iodine (Ranjini and Raju, 2012).

The ingestion of one to two cloves of raw garlic per day is considered safe in adults. The most common side effect of ingested garlic is breath and body odour. Consumption of excessive amounts of raw garlic, especially on an empty stomach, can cause gastrointestinal upset, flatulence and changes in the intestinal flora. There have been reports of allergic dermatitis, burns and blisters from topical application of raw garlic. Garlic appears to have no effect on drug metabolism, although recent studies in healthy volunteers show conflicting results related to garlic's effect on protease inhibitor pharmacokinetics. It has been suggested that patients taking anticoagulants use caution when taking garlic because of its antithrombotic properties. It seems prudent to stop taking high dosages of garlic 7 to 10 days before surgery because garlic can prolong bleeding time and has been associated (in one case report) with spontaneous spinal epidural haematoma (Bhandari, 2012).

Garlic is rich with many active compounds which have various distinctive functions such as antibacterial, antibiotic, anticoagulant, antihistamine, antiparasitic, antifungal, antiprotozoan and antiviral properties, expectorant, diaphoretic, alterative, antidiabetic, diuretic, stimulant, antispasmodic, promotes sweating, lowers blood sugar and blood cholesterol levels and lowers blood pressure. The derivatives of garlic compounds appear to be safe, cheap, and broad-spectrum and immunostimulatory stimulate cellular immunity (Ranjini and Raju, 2012). It is also can be used for the treatment of insomnia and used as antioxidant (Hernawan and setyawan, 2003). In the agricultural field, literature survey had mentioned that garlic tolerates neither excess water nor water stress as both could decrease bulb yield of up to 60 percent. Optimum water application is a pre requisite to

successful garlic production in relation to bulb size, weight and quality. Garlic requires adequate moisture for good establishment, growth, development and final bulb yield and bulb quality. Information extracted from the literature survey mentioned that application of water to garlic at every 4 days interval appeared to give optimum yield and yield attributes in garlic (Doro, 2012).

Adhatoda vasica

Adhatoda vasica Nees. (Acanthaceae), with the common name vasaka. Extract of *Adhatoda vasica* leaves has been used for the treatment of various diseases and disorders in Ayurved and Unani medicine (Yadav and Tangpu, 2008). The plant has been used in the indigenous system of medicine in India for more than 2000 years (Singh *et al*., 2011). *Adhatoda Vasica* is a very well known remedy available everywhere and it is especially popular in rural areas (Kumar *et al*., 2010).

It is an evergreen shrub growing throughout Indo Malayan region, Punjab in the North, and Bengal and Manipur in the South East to Tranvacore of Kerala, at an altitude of 1350 m. The plant is also seen distributed in Sri Lanka, Upper and Lower Myanmar, southern China, Laos, and the Malay Peninsular and Indonesian Archipelago (Singh *et al*., 2011).

Adhatoda vasica in other language are as follow: Ya-Zui-Hua in China, Vasaka (Sanskrit), Arusha (Hindi), Bakas (Bengali), Nongmangkha-agouba (Manipuri), Alduso (Gujarati), Adasaramu (Telugu), Adadodai (Tamil), Adusoge (Kannada) and Atalotakam (Malayalam) in India (Singh *et al*., 2011).

It has been used as an herbal remedy for allergen induced bronchial obstruction, asthma, tuberculosis and possesses hepatoprotective activity. In the Naga tribes of northeastern part of India, the leaf decoction of *Adhatoda vasica*, locally called 'sorukni', have a long history of traditional medicinal use, where it is used to get rid of intestinal worm infections. *Adhatoda vasica* revealed to contain alkaloids, glycosides, phenolic components and sterols. The major constituents identified, however, are two alkaloids: vasicine and vasicinone (Yadav and Tangpu, 2008).

Vasaka, also called Malabar nut tree, is well known throughout India. It is tall, with several branches, dense. Leaves are large and lance shaped. It has capsular four seeded fruits. The flowers are either white or purple in colour. Its trade name vasaka is based on Sanskrit name. Vasaka is indigenous to India. It grows all over the India and in the lower Himalayan ranges (Kumar *et al*., 2010).

Vasicine/Peganine is a quinazoline type alkaloid mainly obtained from the plant *Adhatoda vasica*. Few of the main chemical constituents of this plant are vasicine (derived from leaves), 2'-hydroxy-4-glucosyloxychalcone, vasicol (from leaves), vasicinone (from leaves, stem and roots), vasicinol (contained in stem and roots), and deoxyvasicinone (from leaves). It was first isolated from by Sen and Ghose in 1924 (Rachana *et al*., 2011).

A group of researchers from India had mentioned about chemical constituent of the plant a bit in detail when compared to Rancana *et al*. They mentioned that Important chemical constituents of leaf include pyrroloquinazoline alkaloids, vasicine, vasicol, adhatonine, vasicinone, vasicinol, vasicinolone. Vasicine was reported to have bronchodilatory, respiratory stimulant and uterine stimulant effect. Vasicinone was shown to have bronchodilatory, weak cardiac stimulant and antianaphylactic action (Soni *et al*., 2008).

Apart from bronchial obstruction, asthma, tuberculosis and hepatoprotective activities, this plant also having activities like antioxidant, genoprotective, muscle stimulant activity, abortifacient activity, anti-diabetic activity, anticestodal activity, antileishmanial activity, anti-helminthic activity, anti-bacterial activity, anti

ulcer activity (Rachana *et al*., 2011). It is also included in the treatment for fever, malaria, piles, leprosy, skin disease (Soni *et al*., 2008). Vasaka leaves, bark, the root bark, the fruit and flowers are useful in the removal of intestinal parasites (Kumar *et al*., 2010).

Adhatoda is considered safe in recommended usage and dosing. The safety of this herb has not been tested in children and should be avoided, unless directed by a medical professional. Use of this supplement is not recommended during pregnancy (except at birth, and then only under the direction of a medical practitioner.) Care should be exercised when taking this herb with other drugs or supplements that exhibit expectorant or antispasmodic effects (Kumar *et al*., 2010).

The drug vasaka is often taken in the form of juice extracted from its leaves, mixed with ginger or honey, in doses of 15 to 30 ml. The leaves can be made into a decoction or the dried leaves can be given in powder form in doses of 2 grams. Both the decoction and powder are constituents of many preparations used in the Ayurvedic medicine for various affections of the respiratory tract. The root and the bark have the same medicinal uses as the leaves. A decoction of the bark is given in 30 to 60 ml dose and the powdered root- bark in 0.75 to 2 grams dose (Kumar *et al*., 2010).

According to literature survey, concentration level of *Adhathoda vasica*'s protein (8.5 %), vasi-cine (7.5%), vitamine C (5.2%), and fats (2.5%) were found in roots samples of Adhatoda vasica. Whereas, level of such compounds was low in leaves except sugar (16.4%), fiber (5.2%), vasicinone (3.5%), Zn (0.6%), S (1.3%) and Fe (1.2%) (Singh *et al*., 2011).

The plant has been included in the WHO manual The Use of Traditional Medicine in Primary Health Care, which aims to profit health workers in South East Asia to keep them informed of the therapeutic utility of their surrounding flora (Singh *et al*., 2011).

Conclusion

Andrographis paniculata, *Allium sativum* and *Adhatoda vasica* are the three important medicinal plants in which it is used for daily consumption by the user especially in the rural areas. From the literature survey, the plants are having moderate to high medicinal values. Not only rural people are seeking for medical benefits from the medicinal plants but also urban people because trying to eliminate the side effect of synthetic medicine on health. Research using these three plants should not stop here and must be extensively employed by the researchers and try to get more medical properties which are useful for the public.

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