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Andrographis Paniculata Ness, An Ancient Herb to Explore for Its Therapeutic Benefit in Malaysia

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Abstract:
Andrographis paniculata belongs to the genus Andrographis that is widely used for decades due to its known biological activities. It belongs to the Family *Acanthaceae* comprising more than 40 different species. Biomedical literatures indicates the presence of medicinally important enterlabdane diterpenoids, noriridoids, xanthones, flavonoids and other miscellaneous compound that show an important pharmacological activities such as anti-diabetes, antidiarrheal, antibacterial, cardiovascular benefits, anti-inflammatory and hepato protective benefits. Moreover, toxicity studies revealed no toxic effect on Rats. In view of it immense therapeutic benefit this review is aimed at compiling currently available information on *Andrographis paniculata* botanical description, propagation, cultivation, ethno medicinal uses, phytochemistry, pharmacological benefits and toxicology.
Keywords: *Andrographis paniculata*, phytochemistry, pharmacological benefits, ethno medicinal uses.

Introduction

An herb is a plant part or plant used for its therapeutic, scent or flavour and medicinal values to improve health benefit especially dietary supplement. A long history of herb used can be dated back to Human existence. Therefore, defining the benefit and developing methods of exposing it, is of critical importance to Scientist rather than looking at the benefits (Tapsell et al., 2006). Therefore, it is imperative to investigate Plants of medicinal value extensively to enhance our pharmaceutical products for the development of Human kind. Hence the World Health Organisation recommend this area should be extensively review due to inadequate scrutiny and scientific details of most medicinal plants as claimed by Herbalists (Jothy et al., 2012). Medicinal plants have been reported to treat chronic as well as infectious diseases, such as *Andrographis paniculata* Nees (Duraipandiyan, Ayyanar, & Ignacimuthu, 2006). In addition, *Andrographis paniculata* has been used as a medicinal herb for many centuries all over the world. It is widely and extensively used in Ayurveda, Unani and Siddah medicinal preparations as a remedy for various diseases. In Malaysia and other countries it is reported to have multiple clinical applications. It's an important cold property herb, used in fevers to remove toxins from the body. It is used to treat diabetics, upper respiratory tract infections, sore throat, fever, herpes, gastrointestinal tract infections, and some chronic diseases (4). In the light of its important medicinal properties, this review will focus on the botanical description, cultivation, phytochemistry, pharmacological properties, and mechanism of action, toxicological and ethno medicinal uses of *Andrographis paniculata*

2 Botany

Scientific Name *Andrographis paniculata*

Common Names

Hempedu bumi (Malaysia) Kalmegh & Mahatikta (India), Kiryato, Fah Talai Jone (Thailand), Chuan Xin Lian (China).

Synonyms

Ardisia paniculata, Diascorea paniculata, Canna paniculata, Catopsis paniculata, Celtis paniculata, Crocosmia paniculata, Bhesa paniculata, Cussonia paniculata, Brocchinia paniculata, Epidendrum paniculata, Grivellia paniculata, Eucalyptus paniculata, Gypsophilia paniculata, Guzmania paniculata, Hydrangea paniculata, Ivesia paniculata, Julbernadia paniculata, Lepechinia paniculata, Melicope paniculata, Libertia paniculata

Classification

Kingdom	Plantae
Division	Angiospermae
Class	Dicotilydonae
Order	Tubiflorae
Family	Acanthaceae
Genus	*Andrographis*
Species	*paniculata Nees*

Figure 1: *Andrographis paniculata*

Distribution

Andrographis paniculata is more widely spread in Asia south East Asia to south India and Sri Lanka. It is also available in Malaysia (Penang, Pangkor Island south of Penang, Malaca and parts of Bornei). The plant was introduced to Americans a number of decades ago. Andrographis also found in Thailand, Hong Kong and Singapore. However, a precise data on the naturalisation of this species in these Countries is lacking (Niranjan, Tewari, & Lehri, 2010)

Botanical Description

Andrographis paniculata is an annual herb. It grows erect to height of 0.3-1.10m in moist shady places. Leaves are glabrous and flowers are white with rose purples spot on the petals. Stem 0.3-1.0m in height, 2-6mm in diameter and dark green. Leaves up to 8.0cm long and 2.5cm broad, lanceolate, pinnate: flowers small, in lax spreading axillary and terminal sub quadrate, yellowish brown (Sudhakaran, 2012; World Health Organization, 1999)

Propagation

The propagation is either through shattered seeds or vegetative in nature, which is possible in some special cases.

Cultivation

Hempedubumi requires hot and humid conditions with adequate sunshine. It can be cultivated in wide variety of soils including shady waste lands. The herb grows adequately and starts flowering with the onset of monsoon and moderation of temperature at the end of monsoon. Seeds can remain dormant for up to 5-6 months. Small application of organic manure is advised in nursery and one hectare three beds of 10 x 2 m size should be tilled, pulverised and level for healthy seedlings. Proper broadcast on bed surface and covered with thin layer of soil coupled with regular irrigation with water till seedlings emerge in about 6-7 days (Seeds about 250-300g). Mulch is removed to avoid elongation of the seedlings immediately after germination (70-80%). Also, raising seedlings in a shade protect them from heat. However, when seedlings are one month old transplanting is done at a row spacing of 30-45 cm and should be irrigated immediately. Poor to moderate fertile soil can be used for growing the seedlings with the application of 80 kg nitrogen and 40kg phosphorus per hectare but nitrogen can be splitter into two, and can be applied at basal and after 30-45 days after transplanting. Dormancy of the herb is observed in winter. Another 3-6 tons of rotten farm yard can be added in nursery. At the initiation of the flower the content of an active constituent andrographolide is high in the leaves. Although the maximum content of andrographolide is in the leave, the whole plant is harvested, dried in shade and powdered for maximum isolation. If the herb is well maintain it can yield up to 3.5-4 tons per hectare of dried herb (Bhan et al., 2006; Sudhakaran, 2012; Tewari, Niranjan, & Lehri, 2010)

Ethno medicinal Uses

The different part of *Andrographis paniculata* such as aerial parts, roots and whole plant have been used for centuries in Asia as traditional medicine for the treatment of various disease condition. Traditional medical practitioners uses the plant to treat stomach aches, inflammation, pyrexia, and intermittent fevers (Alagesaboopathi, Diwakaran, & Ramachandran, 1999; Balu & Alagesaboopathi, 1993; Jarukamjorn et al., 2010;

Mukherjee, Maiti, Mukherjee, & Houghton, 2006). The whole plant has been used as an antidote for snake-bite and to treat poisonous stings of some insects, and to treat dyspepsia, influenza, dysentery, malaria and respiratory infections (Jarukamjorn et al., 2010; Mukherjee et al., 2006). The leaf extract is a traditional remedy for the treatment of infectious disease, fever causing diseases, colic pain, and loss of appetite, irregular stools and diarrhoea (Saxena, Jain, Bhakuni, & Sharma, 1998). In Malaysia, a decoction of the aerial parts is used to treat common cold, hypertension, diabetes, cancer, malaria and snakebite (Okhuarobo et al., 2014).

Table 1: Uses of Different part of *A. paniculata in* Malaysia

Medicinal uses	Plant part	References
Febrifuge, tonic, stomachic and anthelmintic	root	(Jarukamjorn et al., 2010)
Common cold, hypertension, diabetes, cancer, malaria	aerial	(Kapil, Koul, Banerjee, & Gupta, 1993)
Snake bite, urinary tract infection	aerial	(Jarukamjorn et al., 2010)
Fever, colic pain, loss of apetite, irregular stools, common cold	leaf	(Kapil et al., 1993)
Cough, fever, hepatitis, tuberclosis, mouth ulcers & sores	whole plant	(Jarukamjorn et al., 2010)
Insect sting, dyspepsia, influenza, dysentery	whole plant	(Alagesaboopathi et al., 1999)
Respiratory tract infection	aerial	(Kapil et al., 1993)

3.0 Phytochemistry

A number of compounds have been isolated from *Andrographis paniculata*. There is variation in the active principles collected from this plant due to differences in geographical area, climate change, harvest time and processing method. Phytochemical screening revealed the presence of secondary metabolite which account for its major active constituents. The plant metabolite include terpenoid especially entalabdane diterpene lactone which is most abundant and active, flavonoids, especially flavones, noriridoides, xanthones, and trace amount of micro and macro elements (Okhuarobo et al., 2014).

3.0.1 Terpenoids

A number of terpenoids have been isolated from *Andrographis paniculata*. The commonest and most abundant are diterpenoids (Table 3) lactone which are usually found in aerial part, root and stem. The first diterpenoid to be extracted is andrographolide. It has bitter taste crystalline in nature and colourless compound. The compound was first isolated in 1911 by Goter (Kapil et al., 1993). Other compounds isolated include deoxyandrographolide, neoandrographolide and unusual 23 carbon terpenoid obtained from root and aerial parts (Reddy et al., 2003).

3.0.2 Flavonoids

Flavonoids are of critical importance in the development of an insecticides. (Renugadevi, Ramanathan, Shanmuga, & Thirunavukkarasu, 2013)Renugadevi et al, 2013 report the effect of combination of flavonoids from *Andrographis paniculata* and *Andrograrphis lineata* extracts against Mosquitoes. One of the most common flavonoids isolated from *Andrographis paniculata* are the flavones obtained from aerial, root and whole plant (Table 2)

Table 2: Flavonoids isolated from *Andrographis paniculata*

Compounds	Plant part	Type	References
Xanthones			
1,8-dihydroxy-3,7-dimethoxy xanthone	Root	xanthone	(Okhuarobo et al., 2014)
4,8-dimethoxy xanthone	Root	xanthone	(Luyindula et al., 2004)
1,2-dihydroxy-6,8-dimethoxy xanthone	Root	xanthone	(Okhuarobo et al., 2014)
3,7,8-trimethoxy-1-hydroxy xanthone	Root	xanthone	(Luyindula et al., 2004)
Noriridoids			
Andrographidoid A	Root	noriridoid	(Okhuarobo et al., 2014)
Andrographidoid B	Root	noriridoid	(Luyindula et al., 2004)
Andrographidoid C	Root	noriridoid	(Okhuarobo et al., 2014)
Andrographidoid E	Root	noriridoid	(Gan, Lv, Zhang, & Meng, 2012)
Arabinogalactan	herb	protein	(W.-W. Chao & Lin, 2010)

Table 3: Illustrating Terpenoids obtained from *Andrographis paniculata*

Compound	Physical appearance	Type	Melting point ^{O}C	Plant part	References
Andrographolide	colourless cubes	diterpenoid	230-239	aerial	(Kulyal, Tiwari, & Shukla, 2010)
Neoandrographolide	long colourless needle	diterpene	168	aerial	(Koteswara Rao, Vimalamma, Rao, & Tzeng, 2004)
14-deoxyandrographolide	fine needles	diterpenoid	170	aerial	(Saxena et al., 2000)
Andrographiside	amorphous powder	diterpene	193	aerial	(Perianayagam et al., 2005)
14-deoxy-11,12-didehydroandrographolide	white crystals	diterpenoid	205	aerial	(Kulyal et al., 2010)
14-deoxy-11-oxoandrographolide	crystalline solid	diterpene	101	aerial	(Kulyal et al., 2010)
14-deoxyandrographiside	colourless crystals	diterpenoid	201	aerial	(Kulyal et al., 2010)
3,14-dideoxyandrographolide	colourless needle	dterpenoid	107	aerial	(Okhuarobo et al., 2014)
14-deoxy-12-hydroxyandrographolide	amorphous powder	diterpenoid			(Okhuarobo et al., 2014)

3.0.3 Miscellaneous compounds

A lot of other compounds have been isolated from *Andrographis paniculata* (Table 4) especially from the root part of the plant. Four xanthones molecule where isolated with the aid of thin layer chromatography and mass and nuclear magnetic resonance spectroscopic methods(Cimanga et al., 2004) . Five noriridoides were also isolated (Xu, Chou, Wang, & Wang, 2012). Trace elements (Cr, Mn, Ni, Zn, Cu, Se, Rb, Sr and Pb) and macro elements (K and Ca) were all obtained and quantified (Behera et al., 2010) from *Andrographis paniculata.*

Table 4: Demonstrating miscellaneous compound obtained from *Andrographis paniculata*

Compounds	Physical appearance	Type	Plant part	References
7-o-methoxydihydrowogonin		flavone	whole plant	(Kapil et al., 1993)
7-0-methylwogonin		flavone	root/aerial	(Renugadevi et al., 2013)
7-o-methylwogonin-5-glucoside		flavone	root/aerial	(Behera et al., 2010)
Flavone-1,2-o-glucoside		flavonoid	whole plant	(Gan et al., 2012)
Dihyroskullcapflavone		flavone	whole plant	(W. Chao & Lin, 2010)
5,7,22,, ,3,,-tetramethoxyflavone	colourless solid	flavonone	whole plant	(Behera et al., 2010)
5-hydroxy-7,2,3-trimethoxyflavone	yellow amorphous solid	flavone	whole plant	(Behera et al., 2010)

4.0 Pharmacological benefits of *Andrographis paniculata*

Andrographis paniculata Nees has been used extensively in folk medicine especially around Asian countries. This led scientists to study the plant pharmacological properties to validate the therapeutic action on different ailments applied. Many studies conducted revealed the biological activities of this plant such as anti-inflammatory activity, antidiarrhoel benefits, cardiovascular benefits, hepatoprotective benefits, Immunological benefits/anti-cancer activities, antidiabetic benefits, antimicrobial benefit, respiratory benefits, anti-fertility benefits, inescticidal benefit and toxicity activities (Chandrasekaran, Gupta, & Agarwal, 2010; Dua et al., 2004; Okhuarobo et al., 2014).

4.1 Anti-inflammatory activity

Dehydrandrgrapholide followed by neoandrographolide and andrographolide reduces inflammation caused by histamine, dimethyl benzene and adrenaline (Creaghan & Guest, 1978). However, several reports indicate that andrographolide lowered fever produced by diffirent fever-inducing agents like typhoid , paratyphoid, endotoxins and 2,4-dinitrophenol(Creaghan & Guest, 1978). The anti-pyretic effect of andrographolide was comparable to that of aspirin with weaker analgesic effect which indicates its potential as good subtitute without or less side effects that will be tolerated by most patients (Burgos et al., 2005; Carretta et al., 2009). Andrographolide helps to reduce steps involve in an inflammatory processes. It attnuateTNF- α-induced intracellular adhesion molecule-1 (ICAM-1) expression and also inhibits the TNF-induced endothelial-monocyte adhesion(Habtemariam, 1998). Benefit of andrographolide in an anti-inflammatory process involves reduction of inducible nitrix oxide synthase (iNOS) protein expression through prevention of the *de novo* protein synthesis, decreasing stability through post-transcriptional mechanism (Chiou, Chen, & Lin, 2000; Sheeja, Shihab, & Kuttan, 2006). Furthermore, andrographolide reduced the expression of pro-inflammatory proteins such as cyclooxygenese-2 (COX-2) by inhibiting nuclear factor (NF)-*K*b binding to DNA. andrographolide effect on the expression of inducible NO synthase (iNOS), mRna, protein and enzyme activity in RAW 264.7 macrophages stimulated with lipopolysaccharide (LPS) with interferon-gamma (IFN-gamma) was reported by (Chiou et al., 2000). Morever, andrographolide (1-100 microM) inhibited NO production in a dose dependent manner with an IC50 value of 17.4+/-1.1μM.The findings was cinically proved by Tajuddin and Tariq(Singha, Roy, & Dey, 2003). Another explanation of beneficial anti-infammatory activity of andrographolide is its ability to inhibit neutrophil adhesion/transmigration through supression of macrophage adhesion molecule-1 (Mac-1) upregulation which could be mediated by down regulation of reactive oxygen species (ROS) production via kinase C (PKC) dependent mechanism (Y.-C. Shen, Chen, & Chiou, 2002).Inhibition of T cells activation by andrographolide interfere with the onset of experimental autoimmune encephalomyelitis (EAE) which is been

mediated by CD4(+) T cells and this serve as an animal model for human multiple sclerosis. Andrographolide significantly reduce symptoms in mice by intiating T cell and antibody responses directed to myelin antigens(Iruretagoyena et al., 2005), suggesting a strong antinflammatory activuty of *Andrographis paniculata*. Andrographolide has been reported to posses anti-inflammatory effect in vitro by modulating macrophages and neutrophils and this plays a vital role in pathogenesis of several neurodegenerative diseases such as parkinsons disease (Chiou et al., 2000; Cooper, Palmer, & Chapple, 2013). This inferes that andrographolide may have clinical benefit for treatment of inflammation related neurudegenerative disorders.(T. Wang, Liu, Zhang, Wilson, & Hong, 2004)

4.2 Antidiarrhoel benefits

Diarrhoea is one of the leading cause of death in children under five years of age especially in developing countries. Some of the modern medicines use to relieve symptoms of diarrhea are Kaolin-pectin, bismuth and Loperamide. However, components of andrographolide and neoandrographolie showed similar activity to loperamide(Imodium) . The plant powder can prevent or stop diarrhoea in animal model(Kapil et al., 1993). Extract of *Andrographis paniculata* have shown significant antidiarrhoeal activity against Escherichia Coli(Gupta, Yadava, & Tandon, 1993). *Andrographis paniculata* was used to treat 1,166 cases of bacterial dysentry and 955 case of diarrheoa with an overall 91.5% effectiveness sucess(Carretta et al., 2009), showing its potential as a good subtitute for some antibiotics.

4.3 Cardiovascular benefits

A study done on rats by Wang and Zhao reported that extracts of *Andrographis paniculata* could increase the time taken for blood cloting in diffirent solvents, thus decreasing the chances of subsequent closing of blood vessels(retenosis), after angioplasty(Gupta et al., 1993). In an atherosclerotic rabbit model using extract of *Andrographis paniculata* showed increases of nitric oxide , cyclic guanosine monophosphate, and activity of speroxide dismutase with decline of lipid peroxidase and endothelin. This suggests that *Andrographis paniculata*(Hempedu bumi) has anti-oxidant activity to preserve endothelian function that will lead to balancing of nitric oxide/endothelin (H. W. Wang, Zhao, & Xiang, 1997). In another study, *Andrographis paniculata* decreased the damaged cause to heart muscle in myocardial infarction in dogs when given one hour after the incident (Zhao & Fang, 1990) and activation of fibrionolysis(Jarukamjorn & Nemoto, 2008). *Andrographis paniculata* exract and 14-deoxy-11,12-didehydroandrographolide have shown vasorelaxation and hypotensive effects on concious rats, their right atery and isolated aorta(Yoopan et al., 2007). Also increase in blood pressure by nor-adrenaline was inhibited by andrographolide(Zhu, Halpern, & Jones, 1998). Moreover, the plasma content of circulating angiotensin converting enzyme was reduced by andrographolide in a dose dependent manner on systolic blood pressure of hpertensive rats(Zhang & Tan, 2000). N gv However, andrographolide was not considered to be the hypotensive agent in *Andrographis paniculata.*

4.4 Hepatoprotective benefits

Andrographis paniculata prevented hexachlorocyclohexane induced when administered and increase the activity of ϒ-glutamyltranpeptidase, glutathion-S-transferase and lipid peroxidation in mouse liver suggesting potent anti-oxidant and hepatoprotective effect of Hempedu bumi(Trivedi & Rawal, 2001). Carbontetrachloride induced liver damage in rats and mice was prevented by the arieal part of *Andrographis paniculata*(Hempedu bumi) (Handa & Sharma, 1990; Y. C. Shen, Chen, & Chiou, 2000).

In another study by Zheng andrographolide accumulates throughout the viscera. However, within eight hours 80% was removed and 90% within 48 hours via the urine and gastrointestinal tract, in wich they concluded that *Andrographis paniculata* has a potential remedy in treatment of hepatitis. The inhibitory effect of andrographolide and plant extract on hepatic cytochrome P450s (CYPs) has been estabilished(Pekthong et al., 2008). Antihepatotoxic action of andrographolide against *Plasmodium beergei* K173 induced hepatic damage of *Mastomys natalensis* was reported(CHANDER, SRIVASTAVA, TANDON, & KAPOOR, 1995). In a concious rats and guine pigs andrographolide was reported to stimulate gallbladder and therefore, increase production of bile acid, bile salt and bile flow(Shukla, Visen, Patnaik, & Dhawan, 1992), and this indicate potential of *Andrographis paniculata* in the treatment of Urinary tract infections.

4.5 Immunological benefits/anti-cancer activities

Andrographis paniculata may be beneficial to patients with acquired immuno-deficiency syndromes(AIDS) especially when combine with modern medicines due to its ability to interfere with the viability of human immuno-deficiency virus(HIV)(Purkayastha, Sugla, Paul, Solleti, & Sahoo, 2008). It was postulated that *Andrographis paniculata* stimulates immune system in two approches. One was the antigen specific response; where the antibodies are ment to counteract invading microbes and the other one is a non specific immune response; where macrophages counteract and destroy invaders. This may have beneficial effect against infections

and oncogenic agents(Jarukamjorn & Nemoto, 2008).

Promotion of interferon (IFN)-α, IFN-ϒ, tumor necrosis factor (TNF)-α inductions of peripheral blood mononuclear cells (PBMCs), enhaced phagocytosis activity of peritoneal macrophages, activation of natural killer cells by andrographolide suggested its immunostimulant properties that can modulate both specific and non specific immune fuctions(Jarukamjorn & Nemoto, 2008).

In vitro activity of andrographolide suggest that, it exert it anticancer activity at G0/G1 phase of cell cycle arrest through decreased expression of cyclin-dependent kinase 4(CDK4) and induction of inhibitory protein p27(Jarukamjorn & Nemoto, 2008). Inhibitory growth of human acute myeloid leukemic cells by andrographolide and *Andrographis paniculata* extracts is believe to act through inducing cell cycle arrest, induction of Bcl-2-associated X protein (BAX) expression, derease of B-cell lynphoma 2 (Bcl-2) proteins(Jarukamjorn et al., 2010). Moreover, other mechanisms include, induction of cell cycle arrest at G2/M phase, late apoptosis, collapse of mitochondrial membrane, increase of hygrogen peroxide intracellualaly, decrease of superoxide radicals, and reduction of glutathion has been report(Li, Cheung, Zhang, Chan, & Fong, 2007). Anticancer activity of *Andrographis paniculata* has been reported in B16F0 melanoma and HT-29 xengraft models(Ajaya Kumar, Sridevi, Vijaya Kumar, Nanduri, & Rajagopal, 2004). Jada et al reported antitumor activity against breast can cell line(MCF-7) and colon cancer cell line(HCT-116)(Jada et al., 2007). Andrographolide activates extrinsic caspase cascade of the apoptic pathway comparable to cisplatin and that showed selective cytotoxic activity against prostate cancer cell (PC-3)(Kim, Hwi, & Hung, 2005).

4.6 Antidiabetic benefits.

Ethanolic extracts of *Andrographis paniculata* prevent hyperglycemia and reduction of oxidative stress in diabetic rats(Zhang & Tan, 2000). Study indicates that oral administration of an Ayuvedic formulation fortified with *Andrographis paniculata*, 50mg/kg and 100mg/kg(Ilogen-Excel) for 60 days results in increase of plasma insulin,hepatic glycogen and significant lowering of glucose in the blood(Umamaheswari & Mainzen Prince, 2007). Also equeous extract of *Andrographis paniculata* significantly decreases blood glucose in rats without significantly affecting their weight (Niranjan et al., 2010). Ethanolic extracts of *Andrographis paniculata* inhibits α-glucosidase in an *in vivo* oral carbohygrate tests in streptozocin induced-diabetic rats as well as i*n vitro* study(World Health Organization, 1999).

4.7 Antimicrobial benefit

Micro-organisms that cuases fatal infection in human were shown to be succeptible to Andrographolide. However, (Dua et al., 2004) prove the potency of *Andrographis paniculata* on bateria, fungi and viral organisms(Maiti, Gantait, Mukherjee, Saha, & Mukherjee, 2006a). Activity of *Andrographis paniculata* on infected mice with H1N1, H9N2 or H5N1and its anti-inflenza effect in canine kidney cell line were recently proved in mice(Chen et al., 2009). Dogs infected with filarial worms that causes elephantiasis, were said to recovered when treated with *Andrographis paniculata*. Also in vitro activity against Ascaris lumbricoids in human was estabilished in human(Maiti, Gantait, Mukherjee, Saha, & Mukherjee, 2006b). This might be due to anto-oxidant acitivity of Andrographolide on reactivation of speroxide dismutase(SOD), wich protects the liver(Maiti et al., 2006b). Anti fungal acitivity of *Andrographis paniculata* on keratinophilic fungi on dry-weight method was reported by Qureshi et al(Niranjan et al., 2010)

4.8 Respiratory Benefits

Andrographis paniculata extract was proved to be an alternative treatment remedy in uncompilicated acute upper respiratory tract infections and its symptoms(Maiti et al., 2006b). It is effective against tuberclosis, tonsilitis. In a pilot double-blind study, a siginficant decrease in prevalence and un compilicated symptoms of common cold was obsered compared to placebo when *Andrographis paniculata* extract was administered(Jarukamjorn & Nemoto, 2008). Clinical studies suggestes that *Andrographis paniculata* was effective in decreasing the severity and duration of uncompilicated upper respiratory tract infections when administered within 36-48 hours of symptoms appearance(Jarukamjorn & Nemoto, 2008).

4.9 Anti-fertility Benefits

Several studies have conducted to prove the anti-fertilty of *Andrographis paniculatain* experimemtally in both male and female rats. A dry powder of the plant was reported to stop spermatogenisis in male rats(Maiti et al., 2006b). This might be due to prevention of cytokinesis of the the dividing spermstogenic cell. Powder of *Andrographis paniculata* leaf was shown to have significant contraceptive effect in female rats, suggesting its use as contraceptive agent(Maiti et al., 2006b).

Andrographis paniculata is an important constituent of at least 26 Ayuverdic formulation in Indian pharmacopeae. However, it is use for treatment of variety of ailments like pre-natal and post-natal care, compilicated diseases such as Jundice, malaria, respiratory diseases. Also use in general disease conditions such

as wound healing, cuts, boils (Alagesaboopathi et al., 1999; Hovhannisyan, Abrahamyan, Gabrielyan, & Panossian, 2006).

6.0 Toxicological Assessment

Andrographis paniculata has been long perceived as safe in traditional Chinese Medicine (TCM), Indian and Thailand. Male Rats treated with standardised extract of *Andrographis paniculata* there was no sub chronic testicular toxicity on Organ weight, testicular histology, ultra structural analysis of Leydig cells and testosterone level after 60 days treatment. Also adverse effects reported in the trial were mild, infrequent and self-limiting (Jarukamjorn & Nemoto, 2008). Another report by Guo et al, that when 500mg/kg of Kalmegh was administered to mice daily for ten days, there was no effect on growth, appetite, or stool production. Animals were energetic and normal blood count was observed (Niranjan et al., 2010).

7.0 Conclusion

Andrographis paniculata has been used since ancient times in several Ayuverdic formulation. It is extensively used in India, China and South East Asia. The Aerial part of the plant has been used to treat diabetes, cancer, and Inflammation. Also use to treat snake bite, insect stings, fever, sore throat, cough and wounds. One of the major compound of this plant Andrographolide which is a diterpenoid lactone has shown a very promising biological activities. Phytochemical screening has revealed the presence of flavonoids, terpenoids and other miscellaneous compounds such as xanthones, noriridoids and some trace and macro elements. However, this review has further provide a more details into cultivation phytochemical compounds, pharmacological benefits in order to fully understand the chemical compounds and their biological benefits. However, more clinical studies should be carry out to further confirm the therapeutic benefits of the plant and its constituents.

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Conflict of Interest

No conflict of interest

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