



# REVIEW ON MORPHOLOGICAL MUTANTS AND PHARMACOLOGICAL STUDIES ON *ANDROGRAPHIS PANICULATA* (BURM.F.) NEES

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## Abstract

*Andrographis paniculata* belongs to family Acanthaceae, commonly known as kalmegh is used both in Ayurvedic and Unani system of medicines for a number of ailments allied to digestion, hepatoprotection, hypoglycaemic and as antibacterial, analgesic, anti-inflammatory, Vermicidal and antipyretic. The objectives of this study Gamma-ray irradiation is a conventional technique to produce mutants in plant breeding. Dry seeds of *Andrographis paniculata* were irradiated with 5,10,15, 20, 25, 30, 35, 40, 45 and 50KR by a 60Co. The study exposed that gamma radiation extensively determined morphological mutants. However, other parameters show declining tendency with increasing doses of gamma rays as well as Chemicals mutagens such as sodium DES and Sodium azide, EMS through the chemical mutagens induced macro mutation in *Andrographis paniculata*.

**Key words:** *Andrographis paniculata*, Gamma rays, Morphological Mutants, Hepatoprotection, Antibacterial and Anti inflammation.

## Introduction

### *Andrographis paniculata*

*A. paniculata* Nees (Acanthaceae), commonly known as king of bitter is a perennial herb widely cultivated in India, China, South Asia, South Africa, Pakistan and Sri Lanka. The plant is one of the enormous herbs used in various Ayurvedic formulations reported by Mishra (2012). Where it is used to treat infections and some diseases, at the same time as being used before antibiotics were created. Generally, the leaves and roots were used for medicinal purpose. The plant is much smaller in size, exhibits identical appearance and has bitter taste of neem (*Azadirachta indica*). The genus *Andrographis* consists of 28 species of small annual shrubs basically distributed in tropical Asia. Only a small number of species are medicinal of which *A. paniculata* is the most popular Jaideep SY and Tej PS (2012).

### Distribution

The medicinal plant is distributed in tropical Asian countries frequently in isolated patches. It can be found in various habitative plains, hill slopes, waste lands farms,

dry or wetlands, seashore and also road sides. Native population of *A. Paniculata* is distributed all over south India and Sri Lanka which may constitute to the origin centre and diversity of species. The herb is also available in northern states of India, Malaysia, Indonesia, West Indies and America. In India, it is probably found in the plains and hilly areas up to 500 m, which accounts for its extensive use.

### Taxonomical Classification

Kingdom	: Plantae
Sub Kingdom	: Tracheophyta, Vascular plants
Super division	: Spermatophyta, Seed plants
Division	: Angiosperma
Class	: Dicotyledonae
Sub class	: Gamopetalae
Series	: Bicapellatae
Order	: Personales
Tribe	: Justiceae
Family	: Acanthaceae
Genus	: <i>Andrographis</i>

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Species : *Paniculata (Burm.f) Nees*

### Vernacular Names

Tamil : Nilavembu  
 Telugu : Nilavembu  
 Hindi : Kiriya, Kalpanath  
 English : The Creat, King of Bitters

### Morphological Characters of *Andrographis paniculata*

The medicinal leaves and roots of *A. Paniculata* generally grows up to a height of 30-110 cm in moist shady places. The morphological appearance of leaves are simple dark in color, opposite, lanceolate, glabrous, 2-12 cm long, 1-3cm wide, acute apex and entire margin Pholphana N (2004) . The stem is acutely quadrangular in outline, can be broken easily due to its fragile texture and it is much branched.

### Habitat

The herb is initiate in a variety of habitat in plains, hill slopes Lattoo (2006). Waste lands Zhou Z. (1986).

### Mmtational Studies

Medicinal plant species are gift of nature and taking into consideration their global significance it would be worthwhile to raise novel plant types which may meet up the up surging demands of value added products in National and International markets. The methodology of induced mutagenesis may be adopted which provides an opportunity to produce allelic variation at one or more gene loci of interest in a quick span of time, in that way widening the gene pool thus offering scope of suitable selection exploring the existing germplasm. Kharkwal reported that mutation breeding has contributed significantly to the global agriculture by producing more than 3000 mutant varieties with improved production and productivity in about 175 plant species.

Mutagenic treatment and raising of  $M_1$ ,  $M_2$ ,  $M_3$  and  $M_4$  generations

Dry seeds of *A. paniculata* were treated with different concentrations (0.25, 0.50 and 1.00%; treatments for 2h and 4h durations) of ethyl methane sulphate (EMS – Sigma, USA; dilution were made in 0.2M Phosphate buffer) and diethyl sulphate (dES - Sigma, USA; aqueous solution) at  $36^\circ\text{C} \pm 1^\circ\text{C}$  at pH 6.8. Macromutants were carefully screened from  $M_2$  mutagenized plant population throughout the growth period and the frequency of the mutants was assessed as per 100 plants Gaul H. (1964). All the mutants bred true at  $M_4$ . Spacing (between lines and plants) and growth period (mid April to late January) of the plants were uniform

over the generations. No fertilizers were applied during the growth period of the plants.

### Physical Mutagens Induced Morphological Mutants of *Andrographis paniculata*.

#### Gamma Rays:

The use of gamma radiation to induce mutation is a method that has been applied in plant breeding to increase genetic variations Brunner (1995). Gamma rays belong to ionizing radiation and interact with atoms or molecules to produce free radicals in cells. These radicals can damage or modify important components of plant cells and have been reported to affect the morphology, anatomy, biochemistry and physiology of plants differentially depending on the irradiation level. These effects include changes in the cellular structure and metabolism of the plants e.g., dilation of thylakoid membranes, alteration in photosynthesis, modulation of the anti-oxidative system and accumulation of phenolic compounds Kim (2004) Kovacs and Keresztes (2002) Wi *et al.*, (2005). If the dosages are too high, too many plants will be killed because mutagens can have direct negative effect on plant tissue and many mutations can be lethal. This is due to the fact that primary injuries are retardation or inhibition of cell division, cell death affects the growth habit and changes in plant morphology. If the dose is too low, there will not be enough mutation because of low mutation frequently and results in small mutated sector Nazir (1998). These effects are due to the cytological changes such as chromosomal damages, inhibited mitotic division, degeneration of nuclei, cell enlargement etc., have been reported Sparrow *et al* (1952) Pollard (1964) Karpate and Chaudhuri (1997).

#### Pharmacological studies of *andrographis paniculata*:

*A. Paniculata* are andrographolide, andrographin, panicolin, andrographolide, diterpene glucoside-neoandrographolide, andrographidihnes, neoandrographolide, chlorogenic, myristic acide, homoandrographolide, andrographiside andropanoside etc. The different dosage forms of the plant with therapeutic doses are as follows: powder (1-3g), juice (5-10 ml), Decoction (20-40 ml), liquid extract (0.5-1 ml). Sharma *et al.*, 2002. The plant posses anti-inflammatory, antioxidant, Mishra (2009). antihepatitic, Nees, *et al.*, (2006). antihyperglycemic, Singh (2001). anthelmintic Zhang and Tan (2009) antibacterial, Burm (2010). antipyretic, Chandra, (2010). and anticancer activity Kumar, (2004). During the past decade, the indigenous or traditional system of medicine has gained importance in the field of medicine. In most of the developing

**Table 1:** Morphology characteristics of *Andrographis paniculata*.

1. Plant height	30-110 cm
2. Stem	Dark green
Length	30-100
Diameter	2-6mm
Shape	Ouadrangular 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	1-3cm
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	1.9cm x 0.3cm
Color	Yellowish brown
Shape	Subquadrate, numerous
	December to April.

countries, a large number of people depend on traditional practitioners, who in turn are dependent on medicinal plants, to meet their primary healthcare needs. De (2012). Plant-based medicines still play an important role in the primary healthcare of 80% of the world's population in both underdeveloped and developed countries. Sarkar (2012). The amount and type of food consumed are a fundamental determinant of human health. Asif (2011). Worldwide revolution for the improvement of patient safety is gaining momentum; hence the drug safety for the subject becomes even more prominent in the present day scenario. Cultivation of medicinal plants with laboratory-generated species is being attempted on the basis of chemical composition and is likely to be used in increased manner for commercial purpose. These changes may have profound impact on the safety and efficacy of the Ayurveda drugs in the market. Hence, a mechanism is required to be put in place to address the safety issues Asu (2008).

#### Antibacterial Activity

The plant *A. paniculata* is an antibacterial agent capable of counteracting the ill effects of pathogenic microbes Tomoko (2002) Mishra (2013) Premanath, Devi (2011), Deepak (2014). antimicrobial activity of aqueous leaf extract of *AP* was found to have

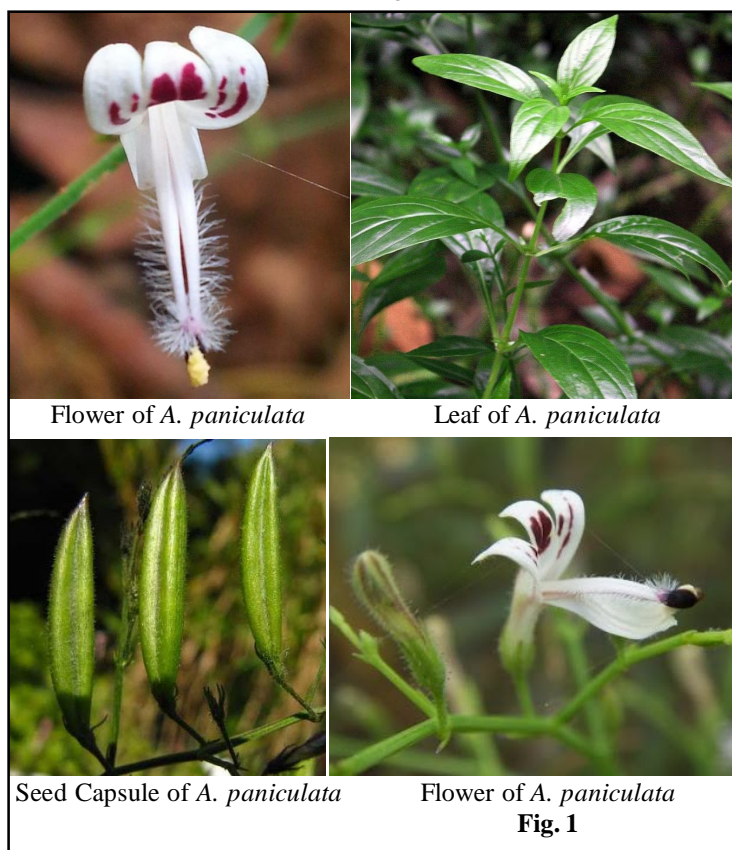
antibacterial activity against *Bacillus subtilis* and *Streptococcus aureus* by Manjusha *et al.*, Shirisha, (2013). A similar conclusion was reached by Radha *et al.* Manjusha (2011). Who found that petroleum ether, acetone, chloroform and methanol extracts of *A. paniculata* leaves and stems, exhibit significant antimicrobial potential against *Enterococcus faecalis*, *Streptococcus pyogenes*, *Klebsiella pneumonia* and *Proteus vulgaris*.

#### Antiviral and antifungal effects

Andrographolide, neoandrographolide and 14-deoxy-11, 12- didehydroandrographolide are reported to be viricidal against herpes simplex virus 1 (HSV-1) without having any significant cytotoxicity at viricidal concentrations Dua (2009). Examined the petroleum ether, acetone, chloroform and methanolic extracts of the plant leaves and stems, in order to evaluate the antifungal potential of *Candida albicans* and *Aspergillus flavus*. The yeast, *Candida albicans* showed susceptibility to 75% of chloroform extracts of the leaves (23.33±1.20mm) and the acetone extracts of stems showed inhibitory effect on the growth of the fungus, *Aspergillus flavus* (23.67±0.88mm) r Manusha (2011).

#### Traditional uses of AP

*A. Paniculata* has been reported to contain antibacterial, antifungal, antiviral, choleric, and



hypoglycemic, hypocholesterolemic, and adaptogenic consequence Bhatnagar In the Unani system of medicine, the plant is believed to possess as anti-inflammatory, antipyretic, astringent, gastric and liver tonic, diuretic, carminative and antihelminthic properties. It is also suggested for curing leprosy, gonorrhoea, and various skin related disorders, owing to its “blood purifying” activity. Juice or an infusion of fresh leaves is effective in curing irregular bowel habits, and loss of appetite, mostly in infant Chopra (1982). Leaves and roots of the plant are also used in general incapacity, dyspepsia associated with

gaseous distension, and in advanced stages of dysentery. In Chinese Medicine, the herb derivative from the leaves or aerial parts of AP is known as Chuanxinlian, Yijianxi or Lanhelian and is known to possess similar properties, as described in Ayurveda, Unani or Traditional Indian Medicine. A variety of preparations and compound formulas of the herb have been used to treat infectious and non-infectious diseases, with significant efficacy reported in case of epidemic encephalitis B, neonatal subcutaneous annular ulcer, vaginitis, cervical erosion, pelvic inflammation, herpes zoster, chicken pox, mumps,



**Fig. 2:** Morphological mutants of *Andrographis paniculata* treated with physical mutagen (Gamma Radiation).



**Fig. 3:** Chlorophyll mutation of *andrographis paniculata* treated with gamma rays.

neurodermatitis, eczema and burn Chang (1987) and Shahid Akbar (2011).

### Antioxidant Activity

Induced raised in lipid peroxidation and increased the actions of antioxidant enzymes *viz.* superoxide dismutase, catalase, glutathione peroxidase and the levels of reduced glutathione in hearts. Moreover, the extract prevented the leakage of lactate Ojha (2009). Protective effect of andrographolide against H<sub>2</sub>O<sub>2</sub> induced cell death, reactive oxygen species, and lipid peroxidation was observed in HepG2 cells. It was found that andrographolide leads to activation of p38 MAP kinase, via adenosine A<sub>2A</sub> receptor signaling, which resulted in enhanced expression of Nrf-2, its translocation to nucleus and activation of HO-1. Andrographolide also activated adenylate cyclase resulting in cAMP formation which in turn activated protein kinase A and reserved GSK-3 $\beta$  by phosphorylation. Inactivated GSK-3 $\beta$  led to retention of Nrf-2 in the nucleus resulting in sustained expression of HO-1 by binding to its antioxidant response element (ARE) (Mittal *et al.*,) dehydrogenase from the heart and recouped the heart from isoproterenol induced myocardial ischemic injury.

### Future Direction

Pharmacological activity of *A. paniculata* was investigated either using crude extracts or isolated bioactive compounds. Although the crude extract showed significant effects, isolation of bioactive compounds and investigation of pharmacology provide more specific knowledge especially about mechanism of actions of compounds. Conformer extraction processes (such as Soxhlet extraction, maceration, and hydrodistillation) have been using by most of the researchers all over the world. However, selection of proper extraction methods is crucial for qualitative and quantitative studies of bioactive compounds derived from medicinal plant Smith, (2003).

### Conclusions

*A. Paniculata* has been treating various diseases and which are highly showing preventative effects against ailments like liver damage, infection, hyperglycemia, cancer, etc. Andrographolide, is a diterpenoid lactone having a diversity of pharmacological effects specified in indigenous system of medicine. In addition to it a great number of pharmaceutical uses, of which andrographolide has some side effects like nausea, vomiting, loss of appetite which can only be seen upon overdosing. As well as through the mutation breeding to improve high yielded and useful as economically and various pharmacological activities. Therefore, researchers may further be

undertaken to develop potent formulations consisting of *Andrographis paniculata* and its isolated molecule, andrographolide by making use of herbal drug delivery systems.

### More Economical Methods

Through the Mutation Breeding Can offer an Economical solution.

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#### Abbreviation

**Gy-** Gamma Rays

**KR-** Kilo Radiation

**IGCAR-** Indira Gandhi Centre for Atomic Research.

**LD-** Lethality Dosage

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