



Review on *Anogeissus pendula* - A Tree Standing Firm in Extreme Conditions

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ABSTRACT

Anogeissus pendula Edgew which belongs to Combretaceae family, tropical plant is socially acceptable and economically viable due to the fuel, timber and fodder value of its foliage. In *Anogeissus* genus, some species are extensively investigated for the therapeutic potential but in spite of one of the major species, on *Anogeissus pendula* very little data available pertaining to the pharmacognostical aspects and pharmacological potential. During review this plant was exposed to cultivate it for its most abundant natural components which are beneficial for provoking pharmacological activities. Due to its occurrence in wild new methodologies were developed to cultivate it as medicinal plants. Raw data obtained ensures that the other species were found potent in showing various therapeutic activities and very less activity done in this plant. This review paper covers the study regarding the cultivation methodology and exploration of its chemical components and activity till date.

Keywords: *Anogeissus pendula*, Deciduous forests, Rajasthan.

INTRODUCTION

A. *pendula*, a deciduous, moderate sized gregarious tree is an important source of fodder, gum, tannin and timber. It is also extensively used for making energy rich charcoal. *Anogeissus pendula* grows as a shrub or small tree with pendulous branches, deciduous, sometimes with spiny branches when young. *Anogeissus pendula* is known by the local name of Safed Dhok in Rajasthan. It is extensively used by the local inhabitants of Rajasthan. The bark is used in anaemia whereas its fruit is used in urticaria, hiccough and constipation.¹ *Anogeissus pendula* is also known as Kardhai. It is a small size tree and has drooping branches. It has got wide adaptability and can grow in dry tracts especially ravines and rocky terrains.² *Anogeissus pendula* is a deciduous species, which sheds leaves from the month of January on wards. Not only does *Anogeissus pendula* has medicinal importance, it is also used for the regeneration of degraded lands. *Anogeissus pendula* has got a wide range of adaptability; it serves as excellent leaf fodder and fuel wood. *Anogeissus pendula* belongs to the family of Combretaceae. Combretaceae family consists of about 20 genera of plants which are usually rich in tannins. *Anogeissus pendula* has been used in Asia and Africa since a long time.³ Parts of the plants used traditionally include stem bark, seed, fruit and twig. These parts are used traditionally for treatment of various ailments such as gastric disorder, wound healing, skin diseases, diarrhea, dysentery, cough and burns. The presence of various useful chemical constituents such as alkaloids and phenolic compounds has been reported in seeds. It has various ethno medicinal uses. It has been found to contain phenolic compounds which have antioxidant potential. *Anogeissus pendula* is used traditionally in

gastric disorders, which may be due to the presence of the phenolic compounds.

DESCRIPTION

Anogesius pendula grows in mixture with *Acacia catechu*, *Ziziphus xzylopyrus*, *Butea monosperma*, etc. It is an important source of fuel wood, which is sold at higher rates as compared to fuel wood from other tree species. The leaves of the tree are edible, they contain high amount of protein (13.61% crude protein on dry weight. pruning of the tree of *Anogeissus pendula* proves to be beneficial and results in increase biomass production, i.e. increased production of leaves and fuel.^{4,5} Studies have mentioned it as the toughest wood which is suitable for the manufacture of all agricultural implements. *Anogeissus pendula* is a small tree, with greyish and silver bark, which develops fissures when the tree grows old. It is woody plants usually used for timber, animal fodder and for manufacture of agricultural tools. It also yields gums and tannins. *Anogeissus pendula* is a tree which is 9-15 m in height and grows in clusters. This tree can retain its adaptability and usually it grows in dry and hot regions where annual rainfall ranges between 400 to 800 mm. It can withstand extreme temperatures ranging from -3 to 47 degrees Celsius. *Anogeissus pendula* is mainly used for its wood which is very hard, tough and strong and comparable in strength to that of teak. Apart from this it also finds its use as a fodder.⁶

Chemical constituents of *Anogeissus pendula*

Anogeissus pendula is a tree growing in clusters in dry and mixed forests of India. Very less or no phytochemical investigations have been reported in its leaves lately. However, a study carried out aimed to isolate chemical constituent from the leaves of *Anogeissus pendula*. In this



study, six polyphenolic derivatives were isolated from the alcoholic extract of the leaves of *Anogeissus pendula* and a novel chromone-substituted dihydrotriflavanol was extracted and its characterization was done.^{7,8} In this study leaves of *Anogeissus pendula* were collected and defatted powder of the leaves was obtained. It was extracted with ethanol in Soxhlet extractor. The extract so obtained was partitioned in two fractions: water soluble extract and ethylacetate soluble fraction. The ethylacetate soluble part was then subjected to chromatography over silica gel. The fractions eluted with Chloroform - methanol yielded yellow solid, which on purification yielded yellow crystalline compound containing two components that were resolved by paper chromatography to obtain the compound (chromone-substituted dihydrotriflavanol) having a melting point of 290-292 degree celsius.⁸

Phenological studies on *Anogeissus pendula*

A study was carried out on woody species of dry forests in Rajasthan. The study was carried out in the Bala-fort reserve forest, which is a tropical dry deciduous thorn forest dominated by *Anogeissus pendula*. In this study phenological observations were made on 26 woody species including *Anogeissus pendula*. Observations were made on leaf initiation, leaf fall, flowering and fruiting. A species was considered in a particular phenophase when more than 80% of the individuals of that species were passing through that phase. On the basis of the fruit maturation activity of a particular species it was grouped into two categories i.e. rapid (r) and lengthy (L) When the fruit maturation period is of 4 months or less, it is considered as "rapid" activity and when it is more than 4 months "lengthy" activity.⁹

Phenological observations in *Anogeissus pendula*

Leaf initiation started by May to June. It was observed in this study that the first shower of pre-monsoon rainfall in the last week of May or first week of June was strongly related to the leaf development. The role of rainfall was further confirmed as leaf flushing delayed in *Anogeissus pendula* in the second year of the study due to drought.⁹

Leaf-fall initiation

Leaf-fall initiation in *Anogeissus pendula* began from November. However, on the second year of the study period the failure of monsoon hastened the initiation of leaf fall, which leads us to the fact the growth period of *Anogeissus pendula* is regulated by soil moisture.⁹

Flowering

Flowering continued throughout the year. However, peak period of flowering was observed in August. In this month *Anogeissus pendula* produced more flowers. In this study it was also found that flowering in *Anogeissus pendula* is asynchronous (i.e. 50% or more individuals of *Anogeissus pendula* were not simultaneously in the flowering phase during the flowering period hence the flowering was considered to be asynchronous.⁹

Fruiting activity

The peak period of maturation of the fruit was September to October. *Anogeissus pendula* exhibited rapid fruit maturation.

Litter fall

A study was carried out among woody species of Plants in a tropical deciduous forest in Rajasthan. In this study *Anogeissus pendula* exhibited highest litter fall. This study was carried out in Bala-Fort Reserve Forest which is situated in the north-eastern part of Rajasthan in the Aravalli hills. Litter fall was estimated using ten litter traps. Litter accumulated in traps was collected on monthly basis and classified into leaf, twig and miscellaneous (seeds, fruits and unidentified litter components). The litter fractions were dried at 80 degree celsius to a constant weight in hot air oven and weighed.¹⁰

Since *Anogeissus pendula* is the dominant tree in this place its litter fall was specially taken into consideration. Litter fall of *Anogeissus pendula* occurs over an extended period of time ranging from July to January and some litter fall also occurs in the Summers. The study results showed that highest litter fall during the study period occurred in July (27g/m²) which consisted of leaves, twig and miscellaneous matter. In this study it was observed that in *Anogeissus pendula* maximum leaf litter fall occurs in September which continues up to December. Twig litter fall in *Anogeissus pendula* increases from January onwards and is at the peak level in July. Twig litter fall in *Anogeissus pendula* is lowest in September to December and finally the miscellaneous litter fall occurred from October to March in *Anogeissus pendula*. The study revealed that *Anogeissus pendula*, suppresses the growth of shrubs such as *Grewia flavescens* and *Adhatoda zeylanica*, which contribute greatly to the litterfall. From the study it was seen that out of total litter fall of *Anogeissus pendula* litter, twig litter and miscellaneous (flower and fruit) litter was 63, 25 and 12% respectively. However, at the top of the slope, leaf litter was 49 percent and the miscellaneous (flower and fruit) litter was 25 percent. Therefore it was concluded provides more resource to reproductive structures in adverse conditions and it forms an important pathway for return of organic matter as well as nutrients to the soil surface and it exerts a great influence on soil formation and fertility.¹⁰

PHARMACOLOGICAL REVIEW

Antioxidant property

Anogeissus pendula was proved to have antioxidant and hepatoprotective activity. The study also revealed that the activity was more in extracts obtained from stem bark than the extract obtained from leaves. This could be due to the more amounts of phytoconstituents present in the stem bark. This study was carried out on Albino rats for Antioxidant activity of *Anogeissus pendula* through DPPH



radical scavenging activity and hydrogen peroxide scavenging. In this study extracts of stem bark and leaves of *Anogeissus pendula* were used. Both the extracts were shown to have potent free radical scavenging activity against DPPH. However, the stem bark extract was found to have more activity than the leaves extract. The study results found that the Stem bark extracts and the leaves extract caused a marked decrease in the values of elevated LFT in the doses of 200 and 400 mg/kg respectively. The stem bark extract caused a significant decrease in SGPT, SGOT, ALP and total bilirubin.¹¹

Anti-diabetic of *Anogeissus* species

Anogeissus species have been proved to have potent antioxidant activity. However, a little is known about its anti-diabetic activity. A study was carried out by to evaluate the antidiabetic potential of *Anogeissus acuminata* on streptozotocin-induced diabetes mellitus. In this study DM was induced in rats by injecting streptozocin. Rats were then treated with *Anogeissus acuminata* extracts for 8 weeks at doses of 100 and 300mg/kg. After that plasma glucose levels and oxidative stress was assessed at weeks 1, 2, 4, and 8. The study results showed that Methanolic extract of AA leaves produced a hypoglycemic and antioxidant effect. Urinary function was also improved. The study concluded that *Anogeissus acuminata* leaf extract demonstrated antidiabetic and antioxidant action.¹¹

Anogeissus pendula as biomass and animal fodder

A study found that pruning upto 75% tree height from 4th of tree planting offers good biomass. The study also found that *Anogeissus pendula* has higher degradability of various nutrients like NDF (Neutral detergent fibre) and ADF (Acid detergent fibre) which shows that *Anogeissus pendula* has potential for higher growth and can be used as a fodder for livestock during lean period[12]. A study carried out in Van Vihar National Park in Bhopal, Madhya Pradesh showed that *Anogeissus pendula* served as an important fodder for Nilgai (*Boselaphus tragocamelus*). In this study food eating parameters of Nilgai was observed. Four areas were selected for this study viz. grassland, savanna, scrubland and woodland. It was observed that Nilgai fed on the fallen leaves of *Anogeissus pendula*. From this study it was concluded that the areas of the national park should be extended and more grass plots and plantation of various trees including *Anogeissus pendula* should be made in order to make more food for these animals.¹²

Wound healing potential of *Anogeissus* species

A study done in 2004 stated the wound healing potential of *A. latifolia*. In this study wound healing potential of ethanolic extract of *Anogeissus latifolia* bark (ALE) for treatment of dermal wounds in rats was studied. Different parameters were used to evaluate the effect of *A. latifolia* on wound healing (period, scar area, tensile strength and hydroxyproline measurements along with wound contraction). The results showed that *A. latifolia*

hastens the wound healing process most importantly by two of its mechanisms, i.e. decreasing the surface area of the wound and increasing the tensile strength. Nitrofurazone ointment was used as a positive control.¹³

Folklore uses of *Anogeissus pendula*

A study carried out by mentions the use of *Anogeissus pendula* by the tribal communities of Chitrakoot, MP. The study was carried out in Chitrakoot. Several tribal communities like Kol, Gond, Mawasi, etc. reside in the Chitrakoot forest area, these communities utilize various plants of this region for food, fodder, fuel, medicine, dye, gum, tanning, thatching, household and farming implements, etc. These tribal people have a familiarity about the medicinal uses of plants found in their village surroundings and forest area. These tribal communities often use the decoction prepared from the twigs of *Anogeissus pendula*. The decoction is applied on burnt parts of body to clear the spot.¹⁴

Use in dysentery

An ethnobotanical study carried out in the Kalinjar Hill, Banda District (U.P.) mentions the use of *Anogeissus pendula*. The information of plants used to treat diseases from rural people was collected and plant species were identified with the help of the floristic treatises. The study was conducted in year 2013-2014. Totally 64 species of plants belonging to 37 families were recorded used by traditional medicine. The study area was the forest area of Kalinjar. The study methods included personal interview, collection of plant specimen, preparation herbarium and identification of plants with the help of floristic treatises. This study stated that stem and bark of *Anogeissus latifolia* is used to treat snake bite and also in diarrhea and also that seeds and barks of *Anogeissus pendula* known as kardhai are used in the treatment of dysentery.¹⁵

Anogeissus pendula as an important Aeroallergen

Anogeissus pendula is to be one of the source of Aeroallergen in their report "Aeroallergens in Clinical Practice of Allergy in India- ARIA Asia Pacific Workshop Report". The report mentioned several aeroallergens such as pollen grains, molds, dust mite and insects play a major role in the pathogenesis of respiratory allergy, particularly asthma and rhinitis. The report mentioned *Anogeissus pendula* to be a common allergenic plant causing spread of aeroallergens in the month of February to April and September to October. Based on clinico-immunological evaluation of pollen antigens, important allergenic pollen in India have been identified. In 1950s a work on pollen antigens and identification of some important allergenic pollen in India was started. It is reported that *Prosopis juliflora* is a major cause of pollinosis with 12% patients showing a positive skin reaction. Later on studies identified some important pollen allergens and list of such plants were made. *Anogeissus pendula* being one of them, other plants in the list were *Ageratum*, *Ailanthus*, *Amaranthus*,



*Artemisia, Cassia siamea, Cenchrus, Chenopodium, Cynodon, Ipomoea, fistulosa, Paspalum distichum and Poa annua.*¹⁶

Fungi growing on *Anogeissus pendula*

Growth of fungi on trees and plants pose a problem as well as may be advantageous for plant growth. A study titled, 'Forest fungi of Central India', have mentioned some of the fungi of Indian forests. Fungi are known to play an important role in growth of forest trees and balance of forest ecosystem. There are some fungi which get associated with the trees and promote their growth e.g. *Mycorrhizal fungus* which directly gets associated with growth of forest trees by helping them in nutrient uptake. Besides mycorrhizal fungi there are fungi, which play an important role in decomposition of forest litter and nutrient cycling. Some of the fungi are also harmful to forest plant and cause damage to root system, stem, branches, foliage, seed, wood, etc. Foliage fungi destroy the leaves in standing trees, for example *lencia* and *dhawa*. Wood decay fungi destroy a lot of wood and timber every year in standing trees as well as in wood depots. In this study they have mentioned *Corynespora combreti* fungi species which grows in *Anogeissus pendula* tree.¹⁶

Relation of plant biomass with growth of *Anogeissus pendula*

A study done in semi-arid zone of Rajasthan particularly Paneri forest block in Udaipur. This area is dominated by Aravalli hills. The soil of this area is usually red or yellow colored soil with sandy clay texture and a pH of 6.8 to 7.7. In this study he observed that various parameters like circumference breast height, tree height, leaf biomass, total plant biomass etc. showed positive correlation with number of growth rings. In this study twenty trees were selected for felling. The branches and leaves of each felled tree was collected and weighed. The samples collected were then dried. Leaf area was determined by the leaf disc method. Growth rings were counted from the polished base of the tree trunk. The average growth rings in all the felled trees were found to be within the range of 12 to 33. The significance of this study is specially in tropical countries where growth rings are not considered to be an adequate measure of age, therefore, it was thought desirable correlate different growth parameters with CBH (Circumference Breast Height).¹⁷ The data obtained was analyzed statistically and the different growth parameters were obtained and were correlated with growth rings and for CBH. From the study results it was observed that the relationship between tree height and CBH was almost linear, it was observed that total biomass increased with an increase in CBH and leaf biomass showed a positive correlation CBH. The leaf biomass also showed a positive correlation with CBH. From this study it was observed that in *Anogeissus pendula* different growth parameters like number of growth rings, tree height, plant biomass and leaf biomass show positive correlation with CBH.

ATTEMPTS TO INCREASE PRODUCTION OF *ANOGEISSUS PENDULA*

Production by tissue culture

One of the problems with the *Anogeissus pendula* is its low germination frequency, because of this planting of this tree becomes difficult or next to impossible forest Departments of different states in India have not been able to carry out planting of this tree so far. A study carried out, described a protocol for large scale propagation of *Anogeissus pendula* by tissue culture. In this study the fruits were collected from both *Anogeissus pendula* and *Anogeissus latifolia* trees and sun dried. The seeds were then dissected out of the fruit and then rinsed with germicidal detergent. The seeds were further sterilized and then cultured on semisolid (Murashige and Skoog) medium. Shoots arising from the seeds were then further cultured on semisolid MS medium in conjugation with auxins. Shoots were subcultured after 30 days, larger size shoot clusters obtained after subculturing were further subdivided into small clusters named propagules.¹⁸

Rooting

Long shoots were excised from the shoot clustered and transferred to various rooting media (MS 1/2 (major salts reduced to half)) [MS 1/4 (major salts reduced to quarter strength)], media was supplemented with auxins such as IAA and IBA. These rooting were performed in 400 ml jars containing 70 ml of medium and incubated for 15 days.

Transplantation

The plantlets so obtained were directly transferred to the soil in polythene bags. The plants were initially maintained over a green house at 28±2 degree Celsius for 7 days after that the plants were shifted to the polyhouse for the next 30 to 45 days. Lastly the plants were retained in the open nursery for about 6 months then transferred into the field.

In this study a success rate of over 85% was achieved. Using this protocol, over 5,60,000 tissue-cultured plants of these two species have been produced and dispatched to various state forest departments for field trials and routine plantations.¹⁸

Isolation of genomic DNA suitable for community analysis from mature trees of *Anogeissus pendula* to arid environment

One of the most common problems associated with *Anogeissus pendula* is its slow rate. A study carried out to isolate genomic DNA from various species of *Anogeissus* and *Terminalia*. For molecular biology applications, isolation of intact and pure genomic DNA (gDNA) is essential however, it is difficult to isolate from mature trees of hot and dry desert regions because of the accumulation of high level of polysaccharides, phenolic compounds, tannins etc.¹⁸ Trees like *Anogeissus* and *Terminalia* are very important components of the Indian Desert ecosystem. These trees are very useful for various



purposes and very well known for their high secondary metabolite content. This study reported the standardized protocol for the isolation and purification of gDNA from seven ecologically and medically important tree species of Combretaceae viz. *Anogeissus* (*Anogeissus sericea* var. *nummularia*, *Anogeissus pendula*, and *Anogeissus latifolia*) and *Terminalia* (*Terminalia arjuna*, *Terminalia bellirica*, *Anogeissus pendula* and *Terminalia chebula*).

The method used by them involved: Washing the sample twice with Triton buffer (2%) then the isolation of gDNA by modified CTAB (cetyl trimethyl ammonium bromide) method employing a high concentration (4%) of PVP (Polyvinylpyrrolidone) and 50 mM ascorbic acid, and purification of this CTAB-isolated gDNA by spin column.

By this method genomic isolation of DNA was successfully done which is very difficult in plants like *Anogeissus pendula*. However, this method can be a useful source in genomic studies of *Anogeissus pendula* in future

Seed germination

One of the most common problems with the growth of *Anogeissus pendula* is its slow rate of germination. A study was carried which showed that the depth of sowing significantly affects the germination of *Anogeissus pendula*. This study was conducted in the botanical garden in the University of Sagar, Madhya Pradesh. The seeds of *Anogeissus pendula* was collected from forests. For the purpose of sowing pots were used. Several depths of sowing i.e. 5, 10, 15, 20, 25, 30 and 40 mm were tried. The soil for sowing was obtained from the forest and sieved for removal of gravels. Sand and decomposed humus was mixed with soil before filling the pots. Hundred seeds were sown in each pot. After sowing of seeds they were covered with the same soil, the pots were then kept under glass house.¹⁹ The number of seedlings in each pot was recorded from the date of commencement of germination. The observations showed that the germination percentage of the seeds increased as the depth of sowing increased from 10 mm to 15 mm and then it gradually decreased with increase in the depth. The low germination percentage at 10 mm may be probably due to decrease in moisture in the later hours of the day. The study concluded that *Anogeissus pendula* show best germination when sown at 10 mm and not more than 15 mm.²⁰ The study further observed that the germination of the seeds of *Anogeissus pendula* is not possible at the depth of 40 mm. this technique could be very useful in future to get rapid and maximum growth of *Anogeissus pendula* in future.

CONCLUSION

Anogeissus pendula is a plant of multiple uses with a very less literature available, hence can be a project for lot of research work. One of the best qualities of this plant is that it can withstand extreme temperatures. It has been used by the forest communities since a very long time. Though the plant can grow in extreme climate, it possesses very slow rate of seed germination. A fungi

called *Corynespora combreti* have also been reported to suppress its growth. Many studies have been carried out to promote the growth of this plant. Its growth have been found to increase by tissue culture. Techniques for enhancing seeds germination based on depth of seed sowing have also been reported which proved to be successful for obtaining optimum growth. Apart from this genomic DNA have also been isolated from this plant which could be useful for molecular biology studies. From the present review we conclude that *A. pendula* is a plant with multiple uses and very few studies are carried out on it. This plant widely grows in extreme temperatures and if more studies are carried out on this plant its use can be exploited to the fullest. Furthermore, since the plant is used extensively by the tribal people, studies should be carried out to evaluate useful chemical constituents from the plants specially its leaves, seeds and stem bark. Since the seeds possess slow rate of germination more studies are required to enhance the growth of this plant.

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