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Review Article

A Review on Pharmacological and Phytochemical Spectrum of Herbal Leaf Extract of *Adina cordifolia*

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ABSTRACT

From Since from very old times Ayurveda is always a deep ocean for many known or unknown medicinal pearls. Some of its gems are always controversial due to their morphological structure and lack of information. Adina Cordifolia is one of them Adina cordifolia which is a highly valued herbal plant used in the Indian medicines, popularly known in the name of Haldu from the 'Rubiaceae family'. It has been shown through numerous phytochemical studies to contain a wide range of bioactive compounds, primarily categorized as tannins, phenols, lactones, carbohydrates, Coumarins, and Benzenoids. These compounds have a variety of pharmacological activities, including antiviral, antifungal, antibacterial, anti-diabetic, and anti-inflammatory, Hepatoprotective, and antioxidant activity. Herbs containing these compounds are increasingly being integrated into modern medicine. It also shown that their own medicinal value against various diseases, herbs have been used to treat wide range of chronic disease like abdominal pain, cough, jaundice, cancer, diabetes and many diseases. This review provided general and updated information on the Phytochemistry, traditional uses, Pharmacognosy, various pharmacological and toxicological values of Adina cordifolia. This review also highlights the various biological activities and it aim is to deconstruct the knowledge and explore its therapeutic potential and future treatment options. The drug is reviewed based on information collected from Web of Science, Scopus, scientific journals, books and Google Scholar. Despite its good pharmacological benefits, it has several harmful effects on the life which is also shown during several studies. This review discusses the botanical description and various pharmacological activities and various benefits of Adina cordifolia.

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INTRODUCTION

From ancient times, medicinal plants are widely utilized all over the globe as one of a kind sources of treatment and may the foremost common human utilize of bio-diversity. Only, In India there are around more than 500 tribal communities secured beneath and approx. 227 ethnic bunches dwelling in nearly 5000 towns in- diverse woodland[1]. Even though, herbs had been estimated for their restorative and fragrant Properties. That pharmaceutical product plays a major role in all inborn people's conventional pharmaceutical and a common component in Ayurveda, Unani, Naturopathic, Homeopathic and other Conventional Oriental. In Rubiaceae family plants are utilized as therapeutic utilize which contain the auxiliary metabolites [2]. It is by distant the biggest family in blooming plants or order gentianales. It is one of the most seasoned families that have branched off on gentianales family tree. It also comprises more over 450 genera and around 6500 species and incorporates trees, occasionally herbs 7-10. Among the numerous plants [3].

According to "The World Health Organization" (WHO) estimated in report on a May 2002 that says up to 80 percent of Africans and a significant proportion of the world's population are still face some form. *Adina cordifolia* is one of those herbal which are used to treat different diseases and abnormality but it is not well known due to its rare availability [4]. It is also utilized by conventional to incessant hack, and used to treat in stomach-ache, jaundice, grain and swelling in stomach it is widely grown in large deciduous forest in Himalayan region and grows mainly in wild or in the hilly areas of Bangladesh. Plant parts of *Adina cordifolia* are traditionally used in India, Ceylon, Bangladesh, Thailand and Burma, since a long

time period. It belongs to the Rubiaceae family. [5].

HISTORY OF ADINA CORDIFOLIA:

Adina cordifolia, also known as the Malabar cat's-claw plant, has a rich history dating back to ancient Indian scriptures like the Vedas, Puranas, and Samhitas. The roots and stems of this plant are mentioned in numerous Vedic texts, including those related to dental hygiene. References to *Adina* can also be found in various ancient writings, such as the Paraskara Guhyasutra, the Atharva parishista, the Yajnavalkya shiksha, the Mandukishiksha, and others. Notably, the Sanskrit name for *Adina*, "Nipa," is mentioned in the Panineeya Asthadhyayi, the Pathanjali Mahabhashya, the Gubhila gruhya sutra, and the Shulwa Prathishakhya. [6]

ESSENTIAL INFORMATION REGARDING ADINA CORDIFOLIA

PLANT DESCRIPTION:

Adina Cordifolia is one of them it is a member of the Rubiaceae family it is mainly found in parts of southern and central India, and also in Sri Lanka, it is commonly known as **Haldu** [see fig1,2].

It is a deciduous tree that typically grown up to about 14-20 meters in height, although it can reach up to 30 meters under optimal conditions. It is commonly found in major part of Indian deciduous forests and the in the region of sub-Himalayan zone up to a height of around 900 meters. [7]

This tree has been traditionally used in folklore medicine for treating various conditions such as chronic jaundice, skin diseases, gastropathy, fever, and cough. The leaves of the tree are circular or oval-shaped, with a heart-shaped base and acute apex [8]. They are slightly hairy when young and can be green or tinged with pink or red. The tree



produces small yellowish flowers that form a halo-like shape around the floral ball. The fruits, which are black when ripe, are minute capsules that split into two dehiscent cocci. The tree sheds its leaves in February and remains leafless until May-June when new leaf growth begins. The tree's distinct stipules become visible during this time. The flower balls reach their peak starting from June and lasts up to August. After the fruit is shed, the tree prepares for new flower ball growth with the onset of the monsoon rains [9].

DISTRIBUTION:

This plant species is native to South East Asia and is found in various countries, including India, Myanmar, Thailand, China, and Malaysia. It inhabits deciduous forests across much of India (excluding arid areas of Rajasthan) and can be found up to 900 meters above sea level in sub-Himalayan region. It is also found to be very common in some forests of South India. The plant thrives in well-drained soil at altitudes between 300 and 1000 meters, and prefers a soil pH between 5.5 and 6.5. It requires an annual temperature range of around 25°C to 35°C and on an average estimated annual rainfall between 1000 and 2000 millimetres.[10-18].



Figure 1: Dried plant of *Adina cordifolia* (Roxb.).



Figure2:Leaves of *Adina Cordifolia*

TABLENO.1: TAXONOMIC CLASSIFICATION[10-17]

Kingdom	<i>Plantae</i>
Class	<i>Magnoliopsida</i>
Sub-class	<i>Asteridae</i>
Superorder	<i>Gentiananae</i>
Order	<i>Gentianales</i>
Family	<i>Rubiaceae</i>
Subfamily	<i>Cinchonoideae</i>
Genus	<i>Adina</i>
Specific epithet	<i>Cordifolia</i>
Botanical name	<i>Adinacordifolia</i> (Roxb.) Benth. & Hook. f.
Synonym	<i>Haldina Cordifolia</i> (Roxb.)

TABLENO.2:VERNACULAR NAMES OFADINA CORDIFOLIA [18-19]

Sr. No.	Language	Names
1.	Hindi	Haldina
2.	Bengali	Keli Kadamba
3.	Marathi	Hed
4.	Gujarati	Haldarvo
5.	Urdu	Halnd
6.	Tamil	Manjkadamba
7.	English Name	Yellow Teak, Saffron Teak
8.	Sanskrit	Haridu

TABLENO.3:CLASSICAL CATEGORIZATION OF ADINA CORDIFOLIA

Sr. No.	Classical text	Gana & Varga
1.	<i>Bhavprakash Nighantu</i> . ²⁰	<i>Pushpa Varga</i>
2.	<i>Madanpala Nighantu</i> . ²¹	<i>Vatadi Varga</i>
3.	<i>Nighantu Adrash</i> . ²²	<i>Manjisthadi</i>

		<i>Varga</i>
4.	<i>Raja Nighantu.</i> ²³	<i>Prabhadradi Varga</i>
5.	<i>Dravyaguna Vijanam.</i> ²⁴	<i>Jwarghnadi Varga</i>

Table.4-Morphological character [25-29]

Sr. No.	Plants Parts	Morphology
1.	Leaves	Leaves Reverse in nature, diameter ranging from 10-20 cm. Orbicular, curtly acuminate. Bottom is cordate whereas top is pubescent.
2.	Bark	Bark Brownish to grey, chunky, sometime off white or silverfish white
3.	Stem	Fluted irregular and buttressed, 15-40m height.
4.	Wood	Normally yellow sometime orange in color .Hard and even.
5.	Flowers	Very attractive, ball shaped with a perimeter 2-3 cm. Yellow in color with a shadow of pink
6.	Fruits	These capsules split into two dehiscent cocci.
7	seed	Narrow and small tailed upwards.

METHOD & MATERIALS: [30]**1. Processing and Collection of plant:**

- Collection of plant sample: The plant leaf of “Adina cordifolia Brandi’s” was collected from Nainital (Haldwani) district of (U.K) Uttarakhand.
- Plant Sample Processing: Firstly, take the plant leaves and washed it thorough and shade dried for two consecutive weeks then grind it to the uniform powder, that Powder was used for the evaluation and testing in different parameters and also used in the preparation of different herbal extracts.

2. Phytochemical Analysis [31-34]:

Raw extract was analysed to determine the presence of specific chemical compounds, including various, flavonoids, Saponin, steroids Terpenoid, gums, alkaloids, tannins and glycosides. The tests followed established methods, using a 10% extract solution for each test, unless specified differently.

2.1: Analysis of phenolic content: For the analysis of phenols the Folin-Ciocalteu Method was used in this process the extracts, with catechol serving as the standard. Minor adjustments were made to the method. McDonald et al. 2001). The results were then shown in terms of grams of catechol /100 grams of extract sample dry weight (DW).

2.1.1 CHEMICAL TEST FOR DETERMATION OF PHENOLS:

a) Ferric Chloride Test: To confirm the presence of phenol, a freshly prepared 1% solution of ferric chloride were added in the sample extract, by the adding of potassium Ferro cyanide. A bluish-green colour indicated the presence of phenol. Separately, a different sample was mixed with water. A small amount of ferric sulphate was introduced into the mixture. The development of a dark-violet colour confirmed the presence of phenol.

2.2 Analysis of total flavonoid content: The total amount of flavonoids in the sample was measured using a method developed by Mandal et al. (2009), with catechin as a standard point of reference. The results were expressed as the equivalent amount of catechin per 100 grams of dried sample.

2.2.1. CHEMICAL TEST FOR DETERMATION OF FLAVENOIDS:

a) Alkaline Reagent Test: A small amount of the sample was mixed with a few millilitres of sodium



hydroxide solution. The availability of flavonoids was testified by the observation of an intense yellow colour which disappeared after the adding diluted HCL.

b) Lead acetate Test: The required amount of sample was added in two drops solution of lead acetate. The confirmation of flavonoids is done by the formation of yellow colour precipitate.

PHARMACOLOGICAL ACTIVITIES OF ADINA CORDIFOLIA

Sr. No.	Part of plant	Properties	Reference
1	Bark & roots	Anti-oxidant	[35] [36] [37] [38]
2	Leaf and stem extract	Anti-bacterial & Anti-cancer	[39] [40] [41]
3	Root bark.	Anti-inflammatory Anti-amoebic & Analgesic	[42] [43] [44] [45]
4	Stem.	Anti-ulcer	[46]
5	Bark extract.	Cytotoxic & Hepatoprotective	[47] [48] [49] [50] [51]
6	Leaf	Anti-Diabetes	[52] [53] [54]

1. Antioxidant Activity:

Adina cordifolia, a traditional medicinal plant, has been used for centuries to treat various conditions.[35] Recent studies have evaluated the antioxidant properties of its leaf, bark, and root extracts for the first time's Results showed that leaf has the wide range of anti-oxidant property.[36] The leaf extract's ability to neutralize free radicals (DPPH and nitric oxide) was also impressive, with IC₅₀ values found to be 48.4 & 110.5 µg/mL, Additionally, leaf extract has a higher concentration of polyphenols, contributing to its potent antioxidant activity.[37] The active compounds (antioxidant) were found in high quantity in the methanolic herbal extract, which

gives confirmation of the polyphenols and shows the anti-oxidant property. [38]

2. Anti-cancer Activity:

The anti-cancer effects of silver nanoparticles were measured using a colour test (MTT assay). Cells convert the chemical MTT into purple Formosan crystals, and the number of crystals reflects cell health. When exposed to Agness made from leaf and stem extracts were, PC-3 and MDA-MB-231 showed a vital decrease in viability of cancer cells. This effect was stronger with higher doses of AgNPs and longer exposure times. However, leaf and stem extracts alone did not show any anti-cancer activity, suggesting that the AgNPs were responsible for the observed effect such as cell death [39].

3. Anti-bacterial activity:

Disk -diffusion method was the method which was used widely in the evaluation of anti-bacterial effects of AgNPs. It showed that the AgNPs made from leaf and stem extracts of *Adina cordifolia* had a specific inhibition zone against B [40]. However, the leaf and stem extracts alone did not show any antibacterial activity. The AgNPs had higher inhibition values compared to the positive control, Gentamycin. Additionally, the extract of stem AgNPs had more anti-bacterial activity than the leaf-extracted AgNPs. These results were uniform with previous studies done on the bark of the plant having antibacterial properties. The AgNPs' are higher surface-to-volume ratio and smaller size which allowed them to interact closely with the bacterial coating, hindering cell growth. The AgNPs' activity was shown against "gram-negative" bacteria may be attributed to their ability to easily penetrate the thin peptidoglycan coating on the cell wall [41].

4. Anti-inflammatory and analgesic activity:



The bark extract of *Adina cordifolia* (Haldu) were tested for their ability to reduce inflammation and pain. The petroleum ether extract was found to be very effective in reducing inflammation at doses of around 100- 400 mg/kg, ethyl acetate extract was similar effective dose of 400 mg/kg. Both extracts also showed significant pain-relieving effects at doses of 200 and 400 mg/kg[42]. The effectiveness of the extracts depended on the amount given in all experiments. Their abilities to reduce inflammation and pain were similar to the effects of a common prescription medication [43].

5. Anti-amoebic Activity:

The potential for anti-amoebic drugs from traditional Indian herbal plants, which showed that the ethyl acetate and benzene roots & barks extracted from of *Adina cordifolia* gives anti-amoebic activity, with the values of IC₅₀ around 2.92 and 2.50 mg/ml, Using a guided bioassay fractionation, in which skimmin 2 and umbelliferon 1 both were separated from extracts of benzene and ethyl acetate. After treating with aluminium chloride, umbelliferon 1 changed into 7-acetoxycoumarin 1a, which in turn changed into 7-hydroxy-8-acetylcoumarin 2a.26 Using a variety of thiosemicarbazides, a novel sequence of thiosemicarbazones, 3aee of 7-hydroxy-8-acetylcoumarin, was created. Additionally, for umbelliferone and skimmin, IC₅₀ values of 6.38 and 4.35 mM/ml were discovered to be highly strong. In traditional Indian medicinal plants, benzene and ethyl acetate root bark extracts of and in *acordifolia* have promising anti-amoebic effects, with IC₅₀ values of 2.90 & 2.50 mg/m. Guided by bioassays, researcher's isolated 7-hydroxycoumarin (umbelliferon) and 7-b-Dglucosylcoumarin (skimmin) from these extracts[44]. Treatment with aluminium chloride converted umbelliferon into 7-acetoxycoumarin, which was then converted into 7-hydroxy-8-

acetylcoumarin. A series of thiosemicarbazones of 7-hydroxy-8-acetylcoumarin were made using various thiosemicarbazides. Additionally, a methoxy derivative of umbelliferon was also synthesized[45].

6. Anti-ulcers

The anti-ulcer activity of stem of *Adina cordifolia* has been study. The API (7-hydroxycoumarin) were extracted from chloroform with the help of an enzyme which showed H⁺/K⁺ ATPase inhibitory activity[46].

7. Cytotoxic Activity:

Scientists tested the bark of the *adina cordifolia* tree to see how it might fight cancer, worms, and blood clots in the lab.[46] They checked how well it killed brine shrimp to see how cytotoxic it was, and how quickly it paralyzed and killed the worm *Tubifex tubifex* to see how anthelmintic it was. They also saw how well it broke down blood clots using a clot lysis test. The *adina cordifolia* bark's extract was very effective against cancer, being more potent than the standard vincristine sulphate. It also showed strong anthelmintic effects, with potency similar to levamisole, a standard drug[47]. Despite taking longer to cause paralysis (14 minutes, 17 seconds), the bark extract induced death more quickly (3 minutes, 30 seconds) than the regular drug at a higher dosage (1 mg)[48]. The extract's shown thrombolytic activity (52.57%) surpassed the streptokinase (80.51%). This suggests the *Adina Cordifolia* barks has potential as a future therapeutic agent with antitumor, anthelmintic, and thrombolytic properties.[49]

8. Hepatoprotective activity:

In rats with liver damage caused by alcohol, extracts from the *Adina cordifolia* plant showed promise as liver protectors. Both acetone (AEAC)



and aqueous (AQEAC) extracts demonstrated Hepatoprotective effects at 500 mg/kg body weight.[50] They increased total protein levels while decreasing serum levels of bilirubin, alkaline phosphate, and SGOT, indicating improved liver function. Microscopic examination of liver tissue further supported these Hepatoprotective effects. Additionally, blood tests showed that animals treated with these extracts had lower levels of liver damage markers, further highlighting their potential as liver protectors. The effectiveness of AEAC and AQEAC for liver protection was comparable to that of silymarin, a well-known and widely used medication for liver health.[51]

9. Anti-Diabetes activity:

The extract (leaf) t of *Adina cordifolia*, when the dose administered at around 250 & 500 mg/kg, it shows the anti-diabetic effects with Alloxan-induced diabetes in Rats.[52] Diabetes is a metabolic disease characterized by high blood sugar, impaired fat, protein, and carbohydrate metabolism, and long-term complications such as micro vascular, macro vascular, and neuropathy.[53] It affects over 171 million people globally and is expected to increase fourfold by 2030, causing 3.2 million deaths annually. Natural remedies are explored for diabetes management, including the use of *Adina Cordifolia* extracts [54].

Chemical Composition of *Adina cordifolia*:

From the heartwood of the plant, a yellow pigment called adinin, which belongs to the naphtha Quinone group, was extracted along with tannins.[55] Further examination of the heartwood revealed a compound with physical properties similar to adinin. However, it was later discovered to be an alkaloid from the β -carboline series and was renamed adifoline. Other components identified in the heartwood included benzoic acid,

cordifoline, Umbelliferone and β -sitosterol. The heartwood's flavanonides were found to be 5,7-dimethoxy-4-hydroxyflavanone and 7,4-dimethoxy-5-hydroxyflavanone.[56] It contains hydrocarbons (saturated) like nheicosane, n-tricosane, n-pentatriacontane, n-pentacosane, and β -sitosterol. The essential oil, obtained through incision, makes up 5.2-6.8 percent of the total. An early chemical analysis found alkaloids in the stem bark. The root bark's ethanol extract yielded a novel coumarin glycoside called adicardin, which is an umbelliferone 7-apiglucoside [57].

Phytocompounds in *Adina cordifolia*

Scientists used specific measurements to identify 66 chemical compounds in the plant extracts:

Molecular weight (MW), Time it takes for the compounds to pass through a chemical separation process **Retention Time (RT)**, **Chemical formula (MF)**, **Concentration** (amount present).

The Percentage of Identified Phytocompounds in Different Extracts is: [58, 59]

- Chloroform extract: 61.74%
- Ethyl acetate extract: 80.42%
- Acetone extract: 60.88%
- Methanol extract: 45.59%

The other Key Compounds were identified from Leaf Extracts are:-

- Vitamin E: 2.9-5.8%
- Neophytadiene: 2.0-2.4%
- Phytol: 1.1-9.42%
- Transsqualene: 15.4-42.1%

USES:[60, 61, 62, 63]

Sr. No.	Part Used	Used In
1	Latex ⁶⁰	Tooth Ache
2	Stem Bark Juice ⁶¹	In Rheumatism



3	Leaves ⁶²	Cough & Cold
4	Fresh Bark ⁶³	Used Internally for Stomach -Ache

CONCLUSION:

This study provides insights for researchers to explore the potential of these plants for improving public health. This study aimed to gather extensive information about the medicinal properties, physical appearance, microscopic structure, quality standards, chemical analysis, powder properties, fluorescence behaviour, and cell strengthening activity of *Adina Cordifolia*, a plant with several active compounds and to shed light on Potential of herbal plant *Adina cordifolia* and their components for prevention and treatment in various ailments.

FUTURE ASPECTS:

Future research may explore the therapeutic potential of the isolated compounds for clinical applications and enhancing existing drug treatments. It is crucial to appreciate and preserve our natural heritage, encouraging further investigation into the pharmacological properties of *Adina cordifolia*. This study provides insights for researchers to explore the potential of these plants for improving public health.

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