

# Review article on *Averrhoa bilimbi*

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**Abstract:** *Averrhoa bilimbi* L (Family: Oxalidaceae) is commonly known as bilimbi, cucumber tree, or tree sorre. This plant is valuable for antimicrobial, antioxidant, antibacterial, antifungal, cytotoxic, antidiabetic, antihypertensive, anticoagulant, anticancer, antiallergy and Hepatoprotective effect. This present review is focused on the Pharmacognostical characters like Scientific classification, Vernacular name, Chemical constituents, and the plant potential in biological activity. This review will be more useful for student further research.

**Keywords:** *Averrhoa bilimbi*, Phytochemistry, Pharmacology

## I. INTRODUCTION

Plants play a vital role from ancient times where man used plant as a source of drug or drug itself to cure various diseases. About 6000 species of medicinal plants in India have high potential values unfortunately; very few of them were studied chemically and pharmacologically for their medicinal benefit. *Averrhoa bilimbi* (commonly known as bilimbi, cucumber tree, or tree sorre is a fruit-bearing tree of the genus *Averrhoa*. *Averrhoa bilimbi* is a small tropical tree native to Malaysia and Indonesia.

Pharmacognosy:

Scientific Classification:

Kingdom: Plantae

Division: Magnoliophyta

Class: Dicotyledonae

Subclass: Rosidae

Order: Oxalidales

Family: Oxalidaceae

Genus: *Averrhoa*

Species: bilimbi L

Vernacular names

Creole: bimbling plum, blimblin

English: bilimbi, cucumber tree, tree sorrel

Filipino: kamias

French: blimblim, blinblin, carambolier bilimbi, cornichon des Indes, zibeline, zibeline blonde Indonesian: belimbing asam, belimbing wuluh

Khmer: tralong tong

Malay: belimbing asam, belimbing buloh, billing.

Spanish: grosella china, mimbros, pepino de Indias, tiriguro, vinagrillo

Thai: kaling pring, taling pling

## 1. Description

Parts used: Leaves, Flower, Fruits

The tree is attractive, long-lived, reaches 16 to 33 ft (5-10 m) in height; has a short trunk soon dividing into a number of upright branches. The leaves, very similar to those of the Otaheite gooseberry and mainly clustered at the branch tips, are alternate, imparipinnate; 12 to 24 in (30-60 cm) long, with 11 to 37 alternate or subopposite leaflets, ovate or oblong, with rounded base and pointed tip; downy; medium-green on the upper surface, pale on the underside; 3/4 to 4 in (2-10 cm) long, 1/2 to 1 1/8 in (1.2-1.25 cm) wide. Small, fragrant, 5-petaled flowers, yellowish-green or purplish marked with dark-purple, are borne in small, hairy panicles emerging directly from the trunk and oldest, thickest branches and some twigs, as do the clusters of curious fruits. The bilimbi is ellipsoid, obovoid or nearly cylindrical, faintly 5-sided, 1 1/2 to 4 in (4-10 cm) long; capped by a thin, star-shaped calyx at the stem-end and tipped with 5 hair-like floral remnants at the apex. The fruit is crisp when unripe, turns from bright-green to yellowish green, ivory or nearly white when ripe and falls to the ground. The outer skin is glossy, very thin, soft and tender, and the flesh green, jelly-like, juicy and extremely acid. There may be a few (perhaps 6 or 7) flattened, disc-like seeds about 1/4 in (6 mm) wide, smooth and brown.

## II. PHYTOCHEMISTRY

### 1. CHEMICAL CONSTITUENTS:

In 2018, Jeevigunta Naveena Lavanya Latha reported the fruit extracts contain flavonoids, saponins and triterpenoid. The chemical constituents of *A. bilimbi* include Amino acids, citric acid, cyanidin-3-O- $\beta$ -D-glucoside, phenolics, potassium ion, sugar, vitamin A. The Bark extracts contains - Alkaloids, saponins, flavonoids.

In 2021, H Y Setyawan et al reported *Averrhoa bilimbi* leaves and fruits contain phytochemicals, such as alkaloids, saponins, tannins, flavonoids, phenols, and triterpenoids.

In 2016, H Chinju Merin Abraham reported *Averrhoa bilimbi* fruits contain the presence of flavonoids, Coumarins, Saponins and Phenols was observed. A total of 20 active principles were detected in the LC-MS investigation of the methanolic extract.

In 2021, Ade Chandra IWANSYAH et al reported *A. bilimbi* leaves powder was rich of nutrient contents which carbohydrate was the highest content. The color analysis demonstrated that the more yellow color in a leaves powder of *A. bilimbi* associated with the presence of flavonoids, a class of phenolic group. However, to detect the presence of active chemical group in *A. bilimbi* leaves required further analyses using different tools such as gas chromatography-mass spectrometry (GC-MS), or liquid chromatography-mass spectrometry (LC-MS).

Alhassan Muhammad Alhassan et al reported this plant and the compounds identified so far are mainly volatile oils, fatty acids, and long-chain hydrocarbons with weak medicinal value.

In 2016, Maya S. Nair et al reported *A. bilimbi* fruit and leaf extracts of *A. bilimbi* were identified by qualitative analysis. Freshly prepared methanolic fruit extract was qualitatively tested for the presence of tannin, phlobatannins, saponin, flavonoids, terpenoids cardiac glycosides and anthraquinones using the method described elsewhere [12]. The ethanolic leaf extract was tested for the presence of phenols, alkaloids and flavonoids.

In 2021, Intan Safitri et al reported Leave and fruit of *A. bilimbi* is known to contain several classes of primary and secondary metabolites, namely carbohydrates, proteins, fats, flavonoids, alkaloids, glycosides, saponins, tannins, triterpenoids, and steroids.

In 2018, I. Fidrianny et al *Bilimbi (Averrhoa Bilimbi L.)* belongs to Oxalidaceae family contained an alkaloid, carbohydrate, phenols, flavonoid, saponin, tannin, triterpenoid, steroid.

In 2013, Kumar et al. revealed that there was presence of phenols, saponins, flavanoids, tannins, alkaloids and triterpenoid.

In 2021, H Y Setyawan The *Averrhoa bilimbi*'s phytochemical compounds that have been identified are alkaloids, saponins, tannins, flavonoids, phenols, and triterpenoids.

## III. PHARMACOLOGICAL ASPECTS:

### 1. Antimicrobial activity:

In 2016, Seri Intan Mokhtar et al reported that the water extracts of *Averrhoa bilimbi* at different maturity stages were evaluated to investigate antimicrobial activity against two Gram positive and three Gram negative bacteria by disc diffusion and broth dilution assays. All of the bacterial isolates showed varying degrees of sensitivity towards *A. bilimbi* extracts. For disc diffusion assay, Gram positive bacterium, *Staphylococcus aureus* was more sensitive to the extract than *Bacillus cereus* with inhibition zone of 9.3 mm (young fruit), 12.3 mm (mature fruit) and 10 mm (ripe fruit). The findings also demonstrated that the extracts have stronger antimicrobial effects against Gram negative bacteria, *Salmonella* spp. with inhibition zone of 12 mm at young fruit, 11 mm at mature fruit and 9.3 mm at ripe fruit than *Escherichia coli* and *Pseudomonas aeruginosa*.

In 2016, Chinju Merin Abraham et al reported that the presence of bioactive compounds among *bilimbi* makes it a potent herb for future research to combat drug resistance since it has commendable antimicrobial properties.

### 2. Antibacterial activity:

In 2021, Intan Safitri et al reported that *Averrhoa bilimbi*, both the fruit and the leaves, are known to have antibacterial activities against several Gram-positive bacteria and Gram-negative bacteria. Based on the testing of several *A. bilimbi* extracts, Gram-positive bacteria that can be inhibited include *B. cereus*, *B. megaterium*, *B. subtilis*, *M. tuberculosis*, *P. acnes*, *S. aureus*, and *S. pyogenes*. Meanwhile, Gram-negative bacteria that can be inhibited by *A. bilimbi* extract include *E. coli*, *K. pneumoniae*, *P. aeruginosa*, *Pseudomonas fluorescens*, *Salmonella* spp., *S. typhi*, *Salmonella paratyphi*, *S. typhimurium*, *Serratia marcescens*, *S. dysenteriae*, and *V. cholerae*. The antibacterial activity is associated with the chemical content of *A. bilimbi*.

In 2014, Anjuman Ara Begum et al reported that the extracts of *A. bilimbi* have moderate & potent actions as antibacterial & cytotoxic agents. This finding provides an insight into the usage of the plant in traditional treatment of antibacterial, antiscorbutic, astringent, post-partum protective medicine, itches, boils, syphilis, bilious colic, whooping cough, stomach ache, aphthous ulcer and other diseases associated with bacterial infection which could be of considerable interest to the development of new drugs through the isolation of active antibacterial & cytotoxic principles from the leaves of *A. bilimbi*.

In 2016, Chinju Merin Abraham et al reported that *A. bilimbi* methanol, chloroform and petroleum ether fruit extracts were tested against selected panel of bacteria. Different concentrations of the extract (50mg, 100mg, and 150mg) in each solvent were loaded on 0.4mm sterile discs. The tested gram-positive bacteria were more sensitive to the extract when compared to the gram-negative bacteria tested. It is well evident that *A. bilimbi* fruit extract showed applaudable inhibitory activity against the tested pathogens. Further research in this direction is recommended.

### 3. Anti-oxidant activity:

In 2020, Juliana Jumal et al reported that a direct correlation between antioxidant activity and phenolic content of the ethanolic extract of *A. bilimbi*, which might be the foremost contributors to the antioxidant activity of the plant *A. bilimbi*. It also shows higher performance of antioxidant activity of DPPH and FRAP.

In 2018, WETHROE KAPFO reported that the ethyl acetate fraction of bilimbi predominantly comprised lipids which exhibited significant antioxidant and protective properties.

In 2012, Sabiha Sultana Chowdhury reported that the *A. bilimbi* plant extract possesses antioxidant and cytotoxic potential. The findings of the investigation also provide further support to and reinforce the traditional use of the plant in different disorders where free radicals are implicated.

In 2020, Sreethu K Sreedharan et al reported that the antioxidant property of leaf and fruit extract of *Averrhoa bilimbi* was determined in methanol and water and it was found that the alcoholic extract shows better antioxidant property than aqueous extract. A cream was formulated with alcoholic extract *Averrhoa bilimbi* and the evaluation test reveals that the formulated cream from methanolic leaf extract showed that it is safe to be used in the skin to protect from extrinsic oxidation sources. The trend of using herbal skin cream is becoming in demand since it is proven that topical application of anti-oxidant cream will be effective against UV radiation and protect the skin from major consequence of UV damage. In conclusion, the topical application of the formulated cream from *A. bilimbi* extract will help in reducing oxidative damage and give the antioxidant effect to our skin due to its high antioxidant values.

In 2014, A. Noriham et al reported that Antioxidant content of *A. bilimbi* fruits is most probably due to the presence of high phenolic compounds in the Oxalidaceae fruits. Most fruits gave positive results in all phytochemical screening conducted. TPC and TFC were found to be highest in stage 4 of *Averrhoa carambola* L. (tart type). Antioxidant activity from the 3 assays also indicated stage 4 of *Averrhoa carambola* L. (tart type) possessed highest antioxidant activity in all the antioxidant assays conducted. Pearson correlation between the assays indicated that the antioxidant might be contributed by the phenolic compound's presence in Oxalidaceae fruits.

### 4. Anti-hypertensive activity:

Tyagita N et al reported that *Averrhoa bilimbi* fruit extract lowers blood pressure and mean arterial pressure of male albino Wistar strain rat induced with NaCl 8% solution.

### 5. Anti-diabetic activity:

Prashanth Shetty et al reported that the antidiabetic activity of ethanolic extract of fruits of *Averrhoa bilimbi*. The ethanolic extract did not show any signs and symptoms of toxicity and mortality up to 2000 mg/kg dose. The in vitro results of ethanolic fruit extract treated rat hemidiaphragm showed increased glucose uptake and also increased the glycogen storage by tissue. This method proved that two of the mechanism of reduction of blood glucose level by increased utilization of glucose by the tissue and significant increase in the glycogen content, the effect of the *Averrhoa bilimbi* treated rat hemidiaphragm may be because of the reactivation of glycogen synthase system. This focuses the one possible way of antidiabetic action of this extract by improvement of glycogenesis process. Decreased utilization of glucose and glycogen synthesis was observed in control untreated rat hemidiaphragm.

### 6. Anticoagulant activity:

In 2013, Harita Hashim et al reported that *A. bilimbi* possess antihyperglycemic and anticoagulant effects, thus reducing the probability of thrombus formation in blood vessels. This plant may have the potential to reduce the risk of stroke, venous thrombosis, heart attack and other metabolic syndromes associated with clot formation. Apart from treating diabetes, it could be used to reduce the formation of clots during surgical procedures.

### 7. Anticancer activity:

In 2016, S. Jagadish Kumar et al reported that *A. bilimbi* fruit extract showed promising anti-lymphoma activity in Swiss albino mice. Treatment of *A. bilimbi* normalized the hematological parameters significantly (\*\*P < 0.01) by decreasing the high level of white blood cell and by increasing the levels of red blood cells and haemoglobin count when compared with DAL control mice. The treated mice group with *A. bilimbi* fruit extract resulted in significant (P < 0.01) decrease in body weight when compared with the control. The MTT assay also has shown a significant growth inhibition percent (97.96%) for the fruit extract treatment.

### 8. Cytotoxic activity:

In 2013, \*Md. Hasanuzzaman et al reported that the crude methanolic extract of *Averrhoa bilimbi* Linn. (Oxalidiaceae) fruits and its different fractions have been investigated for the evaluation of in vitro cytotoxic potential. The dried and powder fruits were extracted with methanol at room temperature and the concentrated methanolic extract was fractionated by the modified Kupchan partitioning method to provide pet-ether, carbon tetrachloride, chloroform and aqueous soluble fractions. Brine shrimp (*Artemia*

salina) lethality bioassay was used to investigate the cytotoxic potential of *A. bilimbi*. Compared to vincristine sulfate (with LC50 of 0.839 µg/ml) methanolic extract, carbon tetrachloride and pet-ether soluble fractions demonstrated a significant cytotoxic potential (having LC50 of 0.005µg/ml, 1.198µg/ml and 0.781µg/ml, respectively). The LC50 values of chloroform and aqueous soluble fractions were 5.691µg/ml and 6.123µg/ml, respectively. This study reveals that *A. bilimbi* possesses effective cytotoxic properties and hence can be a potential source for the isolation of active principle(s) for cancer therapy.

#### 9. Anti-allergy potential:

In 2021, Agus Budiawan Naro Putra et al reported that the potential of *Averrhoa bilimbi* fruit as an alternative for patients with allergic rhinitis and/or other IgE mediated allergies.

#### 10. Anti-fungal activity:

In 2019, Muhammad Luqman Nordin et al reported that *Averrhoa bilimbi* fruits and leaves extraction do have an antifungal activity against the pathogenic *Candida* species. It is proven that the fruit extracts possess better antifungal activity as it produces larger inhibition zone compare to the leaf extracts. Presence of phenols, flavanoids, saponins, and tannins compound within the extract products are the most important factors that affect the antifungal activity of *Averrhoa bilimbi* fruits and leaves extracts.

#### 11. Hepatoprotective activity:

In 2021, Ronald Fernandes et al reported that serum biochemical markers and histopathological studies in the crude ethanol extract treated group support the hepatoprotective effect and provide evidence for the traditional use of AB for treatment of liver disorders. The larger dose of ethanol leaf extract produced a remarkable hepatoprotective activity, which was comparable to silymarin. The presence of natural phytoconstituents like beta-sitosterol and apigenin.

### CONCLUSION

*A. bilimbi* is a useful medicinal plant in traditional medicine for the treatment of various diseases and in maintaining good health. Pharmacological research conducted over the years have proven that the pharmacological activity of *A. bilimbi*'s leaves and fruits including anti-microbial, anti-bacterial, anti-oxidant, anti-hypertensive, anti-allergic, antifungal, hepatoprotective, cytotoxic, anticoagulant and anti-cancer activity. The several pharmacological investigations, and preliminary phytochemical studies have been reported on this plant and the compounds identified so far are mainly volatile oils, fatty acids, and hydrocarbons with weak medicinal value.

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