

***Averrhoa bilimbi*: A Repertory of Ethnomedical Benefits**

Chandhni P.R^{1*} and Lakshmipriya P.R²

^{1*}Assistant Professor, Department of Food technology, TKM Institute of Technology, Kollam, Kerala

²Ph.D Scholar, Faculty of Fisheries Engineering, Kerala University of Fisheries and Ocean Studies (KUFOS),
Ernakulam, Kerala

*Corresponding Author: chandhnipr189@gmail.com

Averrhoa bilimbi is commonly known as bilimbi. It is a fruit-bearing tree of the genus *Averrhoa* also known as tree sorrel which belongs to *Oxalidaceae* family. It is an underutilized crop mainly cultivated in home gardens. Bilimbi cultivation prefer warm and moist conditions with a proper rainfall but its flowering is initiated by dry season. It bears small flowers which are slightly fragrant. Fruits are oblong shaped flesh berry with a smooth shiny surface and juicy extremely acidic in nature. Bilimbi is reported to have many health beneficial properties like fighting against microbes, as an antioxidant, improving liver health, healing of wounds, lowering blood sugar levels, cholesterol and improving heart health. Since this crop is having many medicinal uses it can be utilized as a flavouring agent, for preparing tasty dishes like Bilimbi toffee, squash, curry, wine vinegar, pickles, etc and as a substitute for tamarind in recipes. They are also frequently consumed raw.

Bilimbi as an Antimicrobial Agent

The widespread development of antimicrobial resistance in recent years had led to a renewed search for newer antimicrobial agents for the treatment of infectious diseases. According to reports, the ethanol extract from the leaves of *A. bilimbi* demonstrates significant antibacterial action against six pathogenic pathogens, including Gram-positive and Gram-negative bacteria. The younger fruits were found to be effective against *E. coli* whereas mature fruits against *S. aureus*. The chloroform extracts of bilimbi's leaves and fruits have showed positive antibacterial activity against many important pathogenic bacterias like *Staphylococcus aureus*, *Staphylococcus epidermis*, *Bacillus cereus*, *Salmonella typhi*, etc (Astillo *et al.*, 2022). It was also used as a natural method of decontaminating shrimps just before its preparation and consumption by reducing the microbial load especially *L. monocytogenes* and *S. typhimurium*. Additionally, it has been found that the leaf extracts exhibit modest antifungal activity against *Candida albicans*, *Cryptococcus neoformans*, and *Blastomyces dermatitidis*.

Bilimbi for lowering cholesterol

The three major types of lipids found in the body are phospholipids, triglycerides, and cholesterol. The main risk factors for the onset of peripheral vascular disease, coronary artery disease, cerebrovascular disease, and cardiovascular disorders are elevated blood lipid levels. Heart attacks and strokes are frequently caused by these disorders. In addition to having an impact on the brain, hypercholesterolemia can constrict the blood vessels in the kidneys, heart, and eyes (Alhassan *et al.*, 2016). Atherosclerosis in the heart leads to a stroke and coronary artery disease. Bilimbi contains bioactive substances such as terpenoids, tannins, phenols, and flavonoids which helps in lowering bad cholesterol (LDL, VLDL) and raise good cholesterol (HDL).

Bilimbi for Antidiabetic activity

Diabetes is a multifactorial illness that can cause a number of problems. There are several disadvantages to the current pharmacological regimens for managing diabetes. There is a need for safer, more effective natural medications with strong antidiabetic effects. *Averrhoa bilimbi* is said to have hypoglycemic properties. The reason for this is because bilimbi extracts are found to have flavonoid chemicals that have the ability to reduce blood glucose levels by blocking the intestinal absorption of glucose and inducing the release of insulin by pancreatic beta cells via the control of calcium metabolism. Additionally, flavonoids provide antioxidant qualities that help shield from free radicals.

Bilimbi against Hypertension

Hypertension is sometimes referred to as a "silent killer" as the people not experience any noticeable symptoms to the condition. Eventhough there is a greater chance of serious health issues with uncontrolled hypertension, most people are less concerned about taking the medication on a regular basis. Bilimbi's flavonoids are found to have blood pressure-lowering effects. It's possible that the flavonoids will widen blood vessels and lessen blood

flow resistance (Melania *et al.*, 2018). Volatile components, including oxalate compounds, phenol, flavonoids, and pectin, amino acids, citric acid, phenolics, and potassium ions are all present in *Averrhoa bilimbi* which contributes to lowering blood pressure.

Bilimbi as Biopesticide

Researchers were especially interested in *Averrhoa bilimbi* because of its flavonoid and saponin levels, which might be tested against insects. Numerous investigations have been carried out to manage termites, cockroaches, and mosquitoes. For vegetable species, *Averrhoa bilimbi* is employed as a biopesticide to manage armyworm. This insecticide has a single active ingredient that performs multiple roles, including insect repellent, antifertility toxin, etc. for larvae, the alkaloid, saponin, and phenol are poisonous substances. This substance can irritate the mitochondria's ability to transport electrons, which prevents the larval cells from activating and ultimately leading to their death.

Future potential as value added products from bilimbi

Bilimbi is abundant in bioactive chemicals and it has the potential to be used as an antibacterial, pest control in agriculture and also as liver medicine. Even though it is a rich source of many beneficial components, it is a fruit that isn't utilized much. The fruit serves as a preservative and flavouring. Another possible product developed is bilimbi-coconut water jam created with enhanced flavor and optimized nutritional qualities (Swedha *et al.*, 2022). Simple and inexpensive juices can also be made from this readily accessible fruit by optimizing the color, flavor and other ingredients. Chutneys can be made with bilimbi in place of raw mango and tamarind. Since it is usually found in home gardens, bilimbi fruits are made to pickle by adding salt and spices like cinnamon,

cardamom, cloves, and black pepper. Moreover, it has high commercialization and marketability potential due to its long storage life and low cost.

Conclusions

Bilimbi's leaves and fruits can be used to cure a variety of illnesses, such as microbial infections, diabetes, and hypertension. It has been shown to be beneficial in complementary medicine and has been clinically verified for pharmacological procedures. Bioactive chemicals are abundant in bilimbi like flavonoids and phenols so the fruit syrup is used to cure internal haemorrhoids, stop rectal bleeding, and treat inflammations. Leaves are used as a paste to fought itchiness, mumps, rheumatic swellings, skin eruptions etc. Advanced research in the field of bioactive compounds contained in this plant will open up many opportunities to bring out the potential benefits and utilize bilimbi for many health issues in the form of novel food preparations.

References

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