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Review Article

An Overview of *Lagenaria siceraria* (Molina) Standl

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ABSTRACT

Lagenaria siceraria (Bottle Gourd, Lauki) is an edible cucurbit long recognized in traditional medicine and dietary practices across Asia, Africa, and other regions. Beyond its nutritional role, the plant exhibits diverse therapeutic properties attributed to bioactive constituents such as flavonoids, saponins, tannins, sterols, and cucurbitacins. Almost all morphological parts—fruit, seeds, leaves, and pulp—contain compounds linked with antioxidant, hepatoprotective, anti-inflammatory, immunomodulatory, and cardioprotective effects. Ethnomedicinal uses include management of gastrointestinal disorders, cardiovascular conditions, and respiratory complaints, as well as applications in liver, kidney, and reproductive health. Phytochemical studies highlight the presence of fixed oils, amino acids, vitamins, and polyphenols, with seeds and fruits showing notable lipid-lowering, hepatoprotective, and antioxidant activity. Pharmacological investigations confirm analgesic, antihyperlipidemic, diuretic, anthelmintic, anticancer, and adaptogenic actions in experimental models, supporting its traditional claims. The plant also demonstrates cardioprotective and antidepressant-like effects, underscoring its potential in integrative healthcare. Due to its adaptability, safety profile, and year-round availability, L. siceraria remains an accessible medicinal resource. However, despite extensive studies on the fruit, the leaves, seeds, and roots remain underexplored. This review consolidates current phytochemical, pharmacological, and ethnomedicinal evidence, while emphasizing the need for advanced mechanistic studies and clinical trials to validate therapeutic claims and explore its development as a candidate for botanical drug formulations.

INTRODUCTION

The Cucurbitaceae family, commonly referred to as the gourd, melon, and pumpkin family, comprises a diverse group of flowering plants. This group consists of 118 genera and roughly 825 species, which are distributed in the warmer areas of the world [1]. In the family Cucurbitaceae, Lagenaria species are the most common. Bottle gourd is of the Lagenaria genus and derives its

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name from the word Lagena (bottle). In older and some modern literature, this species may be denominated as *Lagenaria vulgaris* (Common), *Lagenaria vulgaris* Ser (Common), *Lagenaria leucantha* (white-flowered gourd), however, today it is treated as *Lagenaria siceraria* (Molina) Standley, belonging to Cucurbitaceae family, is a well-known medicinal plant commonly referred to as "lauki" in Hindi and "bottle gourd" in English[2]. The plant is commonly available in India. It is a climbing or spreading herb bearing bottle- or dumbbell-shaped fruits. These fruits, along with the aerial parts of the plant, are consumed as vegetables. Traditional medicine systems in countries such as India, China, Brazil, several European nations, and the Hawaiian Islands have used this plant for its cardiotonic, general tonic, and diuretic properties [3,4]. The cultivated varieties are believed to have originated in Africa and Asia. Bottle gourd is cultivated throughout the year, especially in regions free from frost.

This plant grows in various soil types, but performs best in fertile, well-manured loamy soils. It prefers warm, humid climates, and consistent irrigation is essential if grown during dry periods. Seeds are usually first germinated in nurseries, and once the seedlings develop two to three leaves, they are transplanted to the main field. Alternatively, seeds can be directly planted in beds or pits, with 4-5 seeds grouped. After fielding, the healthiest seedling is retained, and the others are either transplanted or discarded. Transplantation is favoured for early cropping.

In India, two main crops are grown annually. The summer crop is sown between mid-October and mid-March, while the second crop is planted from early March to mid-July. Round fruit varieties are usually preferred for the first crop, while bottle-shaped varieties are reserved for the second. Vines can either trail on the ground or be trained over supports like walls and trees to improve fruit yield [4].

The plant is referred to by various names across Indian languages: Alabu, Tumbi Ishavaaku, Katutumbi, Tiktaalaabu, Alaabu in Sanskrit; Laus, Lokitumbi in Bengali; Dudi, Tumbadi in Gujarati; Lauki, Ghia in Hindi; Isugumbala, Tumbi in Kannada; Chorakka, Churan, Choraikka, Piccura, Tumburini, Cura in Malayalam; Phopla in Marathi; Tumbi, Dani in Punjabi; Shorakkai, Surai, Suraikkai in Tamil; Sorakaya, Anapakaya in Telugu; And Ghiya, Lauki in Urdu [5].

Taxonomical classification

Table 1. Taxonomic classification of *Lagenaria siceraria*

Kingdom	Plantae
Sub kingdom	Tracheobionta
Phylum	Tracheophyta
Division	Magnoliophyta
Class	Magnoliopsida
Order	Cucurbitales
Family	Cucurbitaceae
Genus	Lagenaria
Species	*siceraria*

Vernacular Names [5]

Table 2 Vernacular names of Lagenaria siceraria in selected Indian languages (adapted from [5]).

Tamil	Shorakkai, Surai, Suraikkai
English	Bottle Gourd
Gujrati	Dudi, Tumbadi
Hindi	Lauki, Ghia
Marathi	Phopla
Punjabi	Tumbi, Dani
Telugu	Sorakaya, Anapakaya
Malayalam	Chorakka, Churan, Choraikka, Piccura.
Urdu	Ghiya, Lauki

Morphological description [6].

Table 3. Macroscopical features of Lagenaria siceraria parts (adapted from [6]).

Plant parts	Constituents
Stem	The stem is typically prostrate or climbing in nature. It is angular, ribbed, thick, and brittle, especially when young, and is covered with soft hairs.
Leaves	Leaves are simple with a long, thick, and hollow petiole measuring approximately 25–30 mm.
Leaf Lamina	The leaf blade is usually broad, heart-shaped (cordate), and commonly five-lobed. It has a soft, hairy surface (pubescent)
Flowers:	Flowers are solitary, arise from the leaf axils (axillary), and are pedicellate. They are unisexual, and the plant is monoecious, meaning both male and female flowers occur on the same plant.
Petals:	The flower typically contains five petals, which are white or cream in color and usually bloom during the evening.
Fruits:	The fruits are initially green, turning yellow upon ripening. They are large, densely covered with fine hairs, and occur in various shapes such as cylindrical, flask-like, or globose.
Pulp:	The inner pulp of the mature fruit is pale brown. When dried, the fruit forms a hard, thick-walled, hollow structure.
Seeds:	Seeds are embedded in the spongy pulp, compressed, and have two flat facial ridges.

Figure 1. STEAM

Figure 2. LEAVES

Figure 3. FLOWER

Figure 4. FRUIT

Figure 5. SEED

Microscopic Evaluation of Lagenaria siceraria

Microscopic examination of *Lagenaria siceraria* (bottle gourd) has identified several diagnostic features that can be applied in quality control and botanical authentication.

Leaf: Microscopic observation of leaf powder shows polygonal epidermal cells with straight to weakly wavy anticlinal walls. The stomata are

mostly anomocytic, with some paracytic types being seen, mostly on the abaxial side.

Trichomes: The surface is beset with uniseriate multicellular trichomes that are non-glandular and range from straight to very slightly curved.

Crystals: Calcium oxalate crystals, predominantly rosette and prismatic in form, are found dispersed in the mesophyll.

Xylem and Fibers: Xylem vessels show reticulate thickening, and lignified fibers are present in groups with narrow lumens.

Starch grains: They are usually simple, round to oval in shape, and occur within the parenchymatous tissues of the petiole and lamina.

These features serve to identify *L. siceraria* from other cucurbit species and ascertain its purity in pharmaceutical preparations [7].

Phytochemical Constituents of *Lagenaria siceraria* (Plant Part-wise)

Lagenaria siceraria (bottle gourd) is a treasure house of a diversified range of bioactive phytochemicals present in its various plant parts. The fruit has been reported to be rich in flavonoids, saponins, sterols, cucurbitacins, terpenoids, and vitamins like ascorbic acid. These compounds are the major contributors to the plant's antioxidant, hepatoprotective, and anti-inflammatory properties [8,9]. The pulp of the fruit is also rich in polyphenolic compounds and water-soluble vitamins such as vitamin C and some of the B-complex constituents, and therefore makes it a traditional cardiac tonic and coolant [10].

Seeds

Seeds of the crop are rich in fixed oils, particularly unsaturated fatty acids such as linoleic and oleic acids, proteins, flavonoids, and sterols of plants. They serve to make the seeds valuable in controlling lipid profiles and inflammation [11]. Additionally, their phenol content and sterols have shown effective antioxidant and immune-modulating effects in recent pharmacological research [12].

Leaves and stems

Leaves and stems are less researched but also contain alkaloids, tannins, and glycosides. They may be involved in their use in traditional medicine for respiratory conditions and as a mild diuretic [13]. Roots were also found to possess flavonoids and glycosides, which may be used in detoxing preparations and as a digestive stimulant [14].

This diversity in phytochemicals on a part-to-part basis suggests that Lagenaria siceraria possesses significant therapeutic value and justifies ongoing research in both traditional and contemporary medicine.

Table 4. Phytoconstituents of different parts of *Lagenaria siceraria* (adapted from [15,16])

Sr. No.	Part of Plant	Name of Constituents	Approx. Amount Present
1.	Fruits[21]	Carbohydrates	2.9 %
		Mineral Matter	0.5 %
		Calcium	0.02 %
		Protein	0.2 %
		Fat	0.1 %
		Phosphorous	≤0.01%
		Iron	0.7 mg/100g
		Sodium	11.0mg/100g
		Potassium	86.0mg/100g
		Iodine	4.5mg/100g
		Leucine	0.8mg/g
		Phenyl alanine	0.9mg/g
		Valine	0.3mg/g
		Tyrosine	0.4mg/g
		Alanine	0.5mg/g

		Threonine	0.2mg/g
		Glutamic Acid	0.3mg/g
		Serine	0.6mg/g
		Aspartic Acid	1.9mg/g
		Cystine	0.6mg/g
		Arginine	0.4mg/g
		Proline	0.3mg/g
2.	Seeds[22]	Protein	30.72%
		Carbohydrate	8.3%
		Moisture	2.47%
		Oil	52.54%
		Lagenin	-
		Saponin	-
3.	Seed oil [22]	Free Fatty Acids	0.55%
		Linoleic Acid	64.0%
		Oleic Acid	18.3%
		Saturated Fatty Acid	17.8%
		Unsaponified Matter	18.3%
4.	Roots[22]	Cucurbitacin B	-
		Cucurbitacin D	-
		Cucurbitacin E	-
		Triterpenes	-
		Bryonolic Acid	-
5.	Leaves[22]	Cucurbitacin B	-
		Carbohydrate	-
		Protein	-
		Phytosterol	-
		Saponin	-
		Amino Acid	-
		Phenolic Compound	-
		Tannins	-
		Flavonoids	-

Chemical Structure of Some Phytoconstituents

The chemical structure of active constituents Cucurbitacin B, D, and E, amino acids valine, Arginine, tyrosine, and leucine present in *Lagenaria siceraria*.

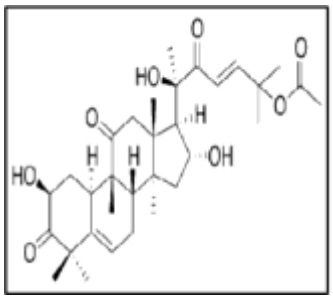

Figure 6.Cucurbitacin B

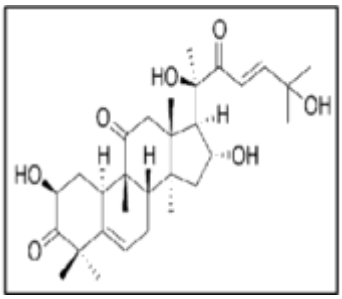

Figure 7.Cucurbitacin D

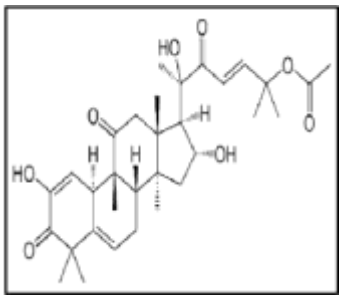

Figure 8.Cucurbitacin

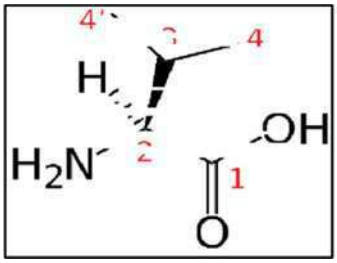

Figure 9. Valine

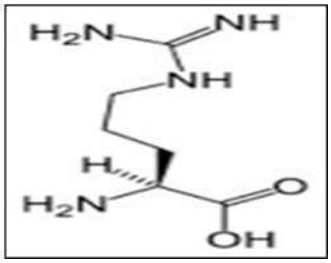

Figure 10.Arginine

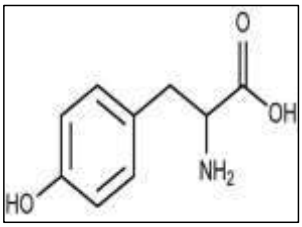

Figure 11.Tyrosine

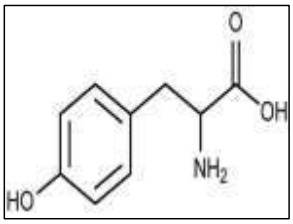

Figure 12.Leucine

Figure [6-12]. Structures of these compounds are adapted from [16].

Traditional uses

Lagenaria siceraria (bottle gourd) has been used extensively in traditional medicine systems across the globe for its vast spectrum of therapeutic effects. The fruit has been known to Ayurvedic as well as folk medicine for its cardiotonic, diuretic, and tonic properties. The fruit is traditionally used for the treatment of hypertension, palpitations, as well as hyperlipidemia, primarily due to its cooling and soothing effect on the cardiovascular system [17,18]. The fruit pulp, either raw or boiled in oil, is employed in the treatment of gastrointestinal disorders such as constipation, jaundice, ulcers, piles, and colitis because of its emetic, laxative, and antibilious action [19,20]. In respiratory therapy, syrups or decoctions from soft fruit are traditionally taken to treat asthma, bronchitis, pectoralis cough, and other bronchial complaints [18,20].

The plant also has significant traditional uses for liver and kidney conditions, where the fruit juice or leaf infusions are used as hepatoprotective and diuretics to help in the condition of jaundice and urinary tract infections [19,21]. Aside from its internal benefits, Lagenaria siceraria is also prized for its function in reproductive systems, specifically as a galactagogue, aiding lactation in lactating mothers. Besides, it has also been utilized as a sedative in instances of insomnia as well as mental tension [17,22].

External applications are also a part of conventional use, in which leaf or pulp paste is used externally to heal boils, tumors, wounds, and skin inflammation [18,21]. The plant seeds are utilized as vermifuge medications, alleviating intestinal worms, and are also used for headache and digestive pain [18,20]. In addition, leaf juice has been used for purgative and emetic purposes and has been used in traditional remedies for baldness, headache, and liver ailments [19,21].

In folk medicine, especially of the Koya and Gutti Koya tribes, wild bitter species of the plant are used as powerful purgatives, whereas oil extracted from seeds, when mixed with castor oil, is used externally for relieving headaches [22]. Lagenaria siceraria flowers are also sometimes used as an antidote for poisoning caused by plants, thereby reflecting their range of traditional uses [18].

Table 5. Medicinal uses of different parts of Lagenaria siceraria (adapted from [23-25]).

Sr. No	Part of Plant	Uses
1.	Fruit	Cardiotonic, Anti-inflammatory, Liver Tonic, Diuretic [23]
2.	Seed	Antitumor, Anti-HIV, Antiviral, Antiproliferative [24]
3.	Fruit Pulp	Antihepatotoxic activity [25]
4.	Fruit Juice	Analgesic, Anti-inflammatory [25], Antioxidant [25]
6.	Epicarp	Antioxidant [25]

Pharmacological Activities of *Lagenaria siceraria*

1. Analgesic and Anti-inflammatory Effects

Fruit juice extract of *Lagenaria siceraria* demonstrated significant analgesic activity in animal models using acetic acid-induced writhing and formalin test. Anti-inflammatory effects were also observed in rats using carrageenan, arachidonic acid, and albumin-induced paw edema. The results suggest strong anti-nociceptive and anti-inflammatory action [26, 28].

2. Antihyperlipidemic Activity

Chloroform and alcoholic extracts of the fruit were tested in normolipidemic and Triton-induced hyperlipidemic rats. The extracts reduced serum cholesterol, triglycerides, and LDL, while raising HDL levels in a dose-dependent manner, suggesting a cardioprotective potential [26, 29].

3. Diuretic Response

Methanol and fruit juice extracts significantly increased urine output and electrolyte (Na^+, K^+, Cl^-) excretion in rats. The activity was comparable to the standard diuretic furosemide, indicating its potential as a natural diuretic agent [26, 13].

4. Anthelmintic Property

Seed extracts of *L. siceraria* were evaluated for in vitro anthelmintic activity using the worm *Pheretima posthuma*. The methanol and benzene extracts caused significant paralysis and death of the worms at concentrations of 100 mg/mL, comparable to the standard drug piperazine citrate [26, 30].

5. Hepatoprotective Activity

Petroleum ether fraction of ethanolic fruit extract significantly reversed liver damage caused by carbon tetrachloride (CCl_4) in rats. Improvements were noted in both biochemical liver markers and liver histopathology, indicating strong hepatoprotective potential [26, 31].

6. Immunomodulatory Action

n-Butanol and ethyl acetate fractions of methanolic fruit extract significantly increased antibody titers, total WBC, and lymphocyte counts in rats, suggesting that *L. siceraria* boosts immune function [26].

7. Antistress and Adaptogenic Properties

Ethanolic fruit extract enhanced stress tolerance in rats exposed to forced swimming and heat stress. Improvements in adrenal gland weight, blood parameters, and stress markers were observed, suggesting adaptogenic properties [26].

8. Cardioprotective Activity

L. siceraria fruit powder (200 mg/kg/day) administered for 18 days showed protective effects against doxorubicin-induced cardiotoxicity in rats. It preserved antioxidant enzyme activity (SOD, GSH), reduced cardiac markers (CK-MB, LDH), and prevented histopathological changes [26, 27].

9. Antioxidant Effects

Acetone extract of fruit epicarp and fresh juice showed high antioxidant activity in DPPH assays. These results were supported by high phenolic and flavonoid contents in the extracts, suggesting significant radical scavenging ability [27, 32].

10. Antihyperglycemic Activity

Methanolic extract of aerial parts showed significant blood glucose reduction in streptozotocin-induced diabetic rats. It also improved lipid profiles, liver enzymes, and oxidative stress markers, demonstrating anti-diabetic potential [27, 33].

11. Anticancer Activity

Methanolic extract of aerial parts exhibited anticancer activity in Ehrlich Ascites Carcinoma (EAC)-bearing mice. It increased lifespan and reduced tumor burden, possibly due to antioxidant and cytotoxic effects [27, 34].

12. Antidepressant-like Effect

Methanolic fruit extract of *L. siceraria* was evaluated in the forced swim test in rats, a model for behavioral despair. It showed comparable antidepressant-like effects to the standard drug imipramine, suggesting mood-elevating potential [27].

CONCLUSION

Lagenaria siceraria, widely known as bottle gourd, is more than just a dietary vegetable—it is a plant with significant medicinal value rooted in both traditional practices and emerging scientific research. Its various parts, including the fruit, seeds, leaves, and pulp, contain a diverse range of bioactive compounds such as flavonoids, saponins, tannins, and sterols. These contribute to its reported pharmacological activities like antioxidant, anti-inflammatory, hepatoprotective, and cardioprotective effects. The plant's availability, simplicity in cultivation, and safety add to its value for therapeutic investigation. Although numerous studies have examined its fruit, the leaves, seeds, and stem are comparatively less studied. Greater depth of investigation, including clinical trials, is required to confirm traditional reports and to elucidate mechanisms of action. This review calls for greater scientific interest in L. siceraria as a potential candidate for future development of herbal drugs and integrative healthcare products.

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