



AN OVERVIEW ON *LAGENARIA SICERARIA* (BOTTLE GOURD)

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ABSTRACT

Cucurbitaceae family is a major source of medicinal agents' science ancient times. Various plants parts including fruits of this family have been established for their pharmacological effect. *Lagenaria siceraria* (Molina) standley (LS) is an annual herbaceous climbing plant with a long history of traditional medicinal uses in many countries, especially in tropical and subtropical regions. Since ancient times the climber has been known for its curative properties, and has been utilized for treatment of various ailments, including jaundice, diabetes, ulcer, piles, colitis, insanity, hypertension, congestive cardiac failure (CCF), and skin diseases. Its fruit pulp is used both as an emetic and purgative, and for its cooling, diuretic, antibilious, and pectoral properties. Boiled in oil this pulp is used to treat rheumatism and insomnia. A wide range of chemical compounds including sterols, terpenoids, flavonoids, and saponins have been isolated from the species. Its extracts have been found to possess various pharmacological activities. Below, we give a comprehensive review of its ethnomedical uses, chemical constituents, and pharmacological profile as a medicinal plant. Particular attention is given to its analgesic, anti-inflammatory, antihyperlipidemic, diuretic, hepatoprotective, anthelmintic, and antibacterial effects so that its potential uses in pharmaceuticals can be better evaluated. The plant has also been suggested to possess antioxidant activity, laxative, cardioprotective, diuretic, hepatoprotective, hypolipidemic, central nervous system stimulant, anthelmintic, antihypertensive, immunosuppressive analgesic, adaptogenic and free radical scavenging activity. The fruit is reported to contain the triterpenoid cucurbitacins B, D, G, H, two sterols viz., fucosterol and campesterol, a terpenoid byonic acid (an allergic compound), flavone-C glycosides (a ribosome inactivating protein) and lagenin. Extract of the *Lagenaria siceraria* seeds show antibiotic activity. It has the highest content of choline among all the vegetables known to man till date, which serves as the precursor of neurotransmitter acetylcholine, which in turn is crucial for retaining and enhancing memory.

INTRODUCTION:

Cucurbitaceae family is commonly known as the gourd, melon or pumpkin family. This family is composed of 118 genera and 825 species, which are widely distributed in the warmer regions of the world. The plants of cucurbitaceae family provide the major contribution for economically important domesticated species and are cultivated for medicinal and nutritional value. Among all plants of the cucurbitaceae family, *Lagenaria* species is the most popular. The bottle gourd belongs to the genus *Lagenaria* that is derived from the word *lagena*, meaning the bottle. The bottle gourd can be found in the forests of India, Moluccas and Ethiopia. The centre of origin has been located as the coastal areas of Malabar (North Kerala) and the humid forests of Dehradun (North India). *Lagenaria siceraria* (Molina) standley commonly known as *lauki* (Hindi) and *bottle gourd* (English). Both its aerial parts and fruits are commonly consumed as a vegetable. Traditionally, it is used as medicine in India, China, European countries, Brazil, Hawaiian island, etc. for its cardiogenic, general tonic and diuretic properties.

Cultivation & Collection: - The cultivated form of *L. Siceraria* is considered to be of African and Asian origin. *Lagenaria siceraria* is a popular vegetable, grown almost all the year round, particularly in frost free areas. It can be cultivated in all kinds of soil, but thrives best in heavily manured loams. It requires warm humid climate or plenty of water when grown during dry weather. Seeds may be sown in nursery beds and seedlings transplanted when they have put forth 2-3 leaves. They may be also sown directly, 4-5 seeds together, in manured beds or pits 5-6ft. apart; the strongest among the seedlings is retained, while others are removed and transplanted. Seedling transplantation is where an early crop is desired, generally two crops raised in India; the summer crop is sown from the middle of October to the middle of March and the later crop, from the beginning of March to the middle of July. Round fruit types are usually sown for the early crop and bottle-shaped types for the second crop. Vines are allowed to trail on the ground or trained over walls. Trees or other support trailing over to give high yield of fruit.

Table 1: Taxonomical Classification:

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Cucurbitales
Family	Cucurbitaceae
Genus	Lagenaria
Species	L. siceraria



Figure 2: *Lagenaria scieraria* leaves



Figure 3: *Lagenaria scieraria* seeds

Morphology:

Lagenaria siceraria is 7.9-15.5 cm long, elliptical shaped having entire margin and parallel venation. The apex of the plant is acute having leathery surface with firm texture, dark green color, bitter taste and characteristic odour. Leaves are simple, up to 400 mm long and 400 mm broad, long petioled, 5-lobed, cordate, pubescent, shortly and softly hairy, broadly egg-, kidney-, or heart-shaped in outline, undivided, angular, or faintly 3–7 lobed, lobes rounded, margins shallowly toothed, crushed leaves nonaromatic. Leaf stalks up to 300 mm long, thick, often hollow, densely hairy, with two small, lateral glands inserted at the leaf base. Tendrils split in two. Flowers are stalked (female flower stalks shorter than male), solitary, unisexual, axillary, monoecious; petals 5, crisped, cream or white colored with darker veins, pale yellow at the base, obovate, up to 45 mm long, opening in the evenings, soon wilting. Fruits are large, variable, cylindrical, flask-shaped or globose with a constriction above the middle; fleshy, densely hairy, indehiscent, green, maturing yellowish or pale brown, pulp drying out on ripening, leaving a thick, hard, hollow. Seeds are many, embedded in a spongy pulp, compressed, with two flat facial ridges, in some variants rather irregular and rugose.



Figure 1: *Lagenaria siceraria* plant

Phytoconstituents of *Lagenaria siceraria*:

The phytochemical analysis of edible portion of the fruit it is shown that it is a good source Glucose and fructose. The amino acid composition of the fruit is as follows: leucines 0.8; phenylalanine 0.9; valine 0.3; tyrosine 0.4; alanine 0.5; threonine 0.2; glutamic acid 0.3; serine 0.6; aspartic acid 1.9; cystine 0.6; cysteine 0.3. The fruit is a good source of vitamins B and a fair source of ascorbic acid. Bitter fruits yield 0.013% of solid foam containing cucurbitacins B, D, G and H, mainly cucurbitacin B. These bitter principles are present in the fruit as aglycones. Leaves contain cucurbitacin B and roots, cucurbitacins B, D and E. *Lagenaria siceraria* shows presence of flavone-C glycoside. A water soluble polysaccharide, isolated from fruiting bodies of *Lagenaria siceraria*, is composed of methyl- α -d-galacturonate, 3-O-acetyl methyl- α -dgalacturonate, and β -d-galactose in a ratio of nearly 1:1:1. This polysaccharide showed cytotoxic activity in-vitro against human breast adenocarcinoma cell line.

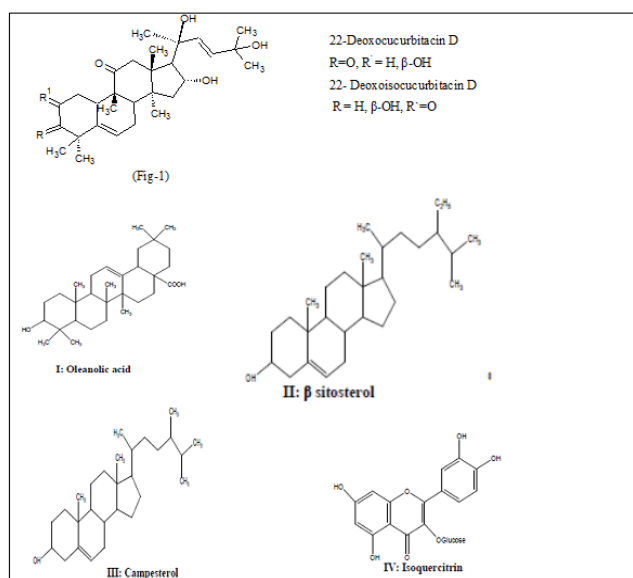


Figure 4: Chemical Constituents Structure

PHARMACOLOGY:

Central nervous system activity:

In this petroleum ether, methanol and chloroform extract shows significant analgesic activity but Petroleum ether extract shows maximum analgesia among them the petroleum ether extract and methanolic extract significantly and in dose dependent manner reduce the nociception induced by acetic acid. In hot plate and tail flick test methanolic and petroleum ether extract shows more significant action than chloroform extract. In the study of the CNS-depressant effect, the methanolic extract significantly reduces spontaneous motor activity at higher doses than petroleum ether extract. The fall off time (motor coordination) was also decreased. A potentiation in the pentobarbitone induced sleep due to the sedative effect of the methanolic extract was observed. The result shows that petroleum ether extract and methanolic extract shows analgesic and CNS depressant activity is due to the presence of different chemical compounds present in that extracts.

Antioxidant activity:

Acetone extract of fruit epicarp of *Lagenaria Siceraria* fruit showed maximum antioxidant activity against in vitro model using DPPH (1, 1-diphenyl-2-picrylhydrazyl). The fresh juice of the fruit also shows antiradical activity. The juice as such and its ten times dilution showed radical scavenging activity whereas 100 and 1000 times diluted juice does not show any radical scavenging activity. Extract is also effective in CCl₄ induced liver damage where it maintained the level of endogenous antioxidant enzymes (superoxide dismutase, catalase and glutathione peroxidase) and marker of lipid peroxidation to that of normal.

Cardioprotective activity:

Vacuum dried extract and methanol extract of *Lagenaria siceraria* fruit was evaluated for its diuretic activity. Diuretic activity was assessed by measuring different parameters like total urine volume, urine concentration of sodium, potassium and chloride and found that both the extracts (100-200 mg/kg, p.o.) showed higher urine volume and exhibited dose dependent increase in excretion of electrolytes when compared with respective control.

Antihyperglycemic activity:

Antihyperglycemic activity of methanol extract of *Lagenaria siceraria* aerial parts (MELS) for its purported use in diabetes has been reported. Hyperglycemia was induced by streptozotocin (50 mg/kg, i.p.) in rats. Treatment was done by MELS at doses of 200 and 400 mg/kg, p.o. for 14 days. Glibenclamide (500 µg/kg) was used as a reference drug. Antihyperglycemic potential was assessed by fasting blood glucose (FBG) measurement (on days 0, 4, 8 and 15), biochemical tests (SGPT, SGOT, ALP, total cholesterol, triglycerides), antioxidant assay (lipid peroxide, catalase and glutathione) and histologic study of the liver, kidney and pancreas tissue. Significant reduction ($P < 0.001$) in FBG levels was observed with treatment duration. Antioxidant and biochemical parameters were significantly improved by MELS and glibenclamide treatment. Histologic observations showed good correlations with the results obtained. The study explored the potent antihyperglycemic activity of MELS, which shows presence of good Flavonoid content in *lagenaria siceraria* plant.

Cytotoxic activity:

Triterpenoids from *Lagenaria siceraria* showing Cytotoxic Activity. Air-dried pieces of the stems of *L. siceraria* (19.4 kg) were extracted three times with methanol at room temperature. The methanolic extract was evaporated in vacuum to give a black residue, which was suspended in H₂O and then partitioned sequentially using EtOAc and n-BuOH. The EtOAc fraction (195 gm) was chromatographed over silica gel, using mixtures of n-hexane and EtOAc of increasing polarity as eluents. Twenty-two fractions were collected. The cytotoxicity of compounds 1-9 was measured using the MTT [3-(4,5-dimethylthiazol-2-yl)-2,5-Diphenyltetrazolium bromide] colorimetric method based procedure. Compounds 3b -O-(E)-coumaroyl-D: C-friedooleana-7, 9 (11)-dien-29-oic acids and 20-epibryonolic acid showed significant cytotoxic activity against the SK-Hep 1 cell line with IC₅₀ values of 4.8 and 2.1 mg/ml, respectively.

Anticancer activity:

Cancer is one of the leading causes of mortality worldwide. Many of the cucurbitaceae plants possess

antitumor activity. On the basis of traditional use, the present study was carried out to evaluate the anti-cancer activity of methanol extract of *Lagenaria siceraria* (Mol.) Standley [Cucurbitaceae] aerial parts (MELS) on Ehrlich's Ascites Carcinoma (EAC) model in mice. After inoculation of EAC cells into mice, treatment with MELS (200 and 400 mg kg⁻¹) and standard drug, 5-Fluorouracil (20 mg kg⁻¹) were continued for 9 days. Evaluation of the effect of drug response was made by the study of tumor growth response including increase in life span, study of hematological parameters, biochemical estimations and antioxidant assay of liver tissue. Experimental results revealed that *L. siceraria* possesses significant anticancer activity which may be due to its cytotoxicity and antioxidant properties. Further research is ongoing to find out the bioactive principle(s) of MELS for its anticancer activity.

Anticancer activity of methanol extract of *Lagenaria siceraria* aerial parts has also been reported on Ehrlich's Ascites Carcinoma (EAC) model in mice. After inoculation of EAC cells into mice treatment with MELS (200 mg and 400 mg/kg) and standard drug 5-fluorouracil (20 mg/kg) were continued for 9 days. Evaluation of the effect of drug response was made by the study of tumour growth response including increasing in life span, study of haematological parameters biochemical estimation and antioxidant assay of liver tissue. Experimental results revealed that *L. siceraria* posses significant anticancer activity which may be due to its cytotoxicity and antioxidant properties.

USES:

1. The fruits, leaves, stem, seeds and oil of *Lagenaria siceraria* are traditionally used in the treatment of jaundice, diabetes, ulcer, piles, colitis, insanity, hypertension, congestive cardiac failure, and skin diseases.
2. The fruit pulp is used as an emetic, sedative, purgative, cooling, diuretic, antibilious, and pectoral.
3. The flowers are an antidote to poison.
4. The stem bark and rind of the fruit are diuretic.
5. The seed is vermifuge.
6. Extracts of the plant have shown antibiotic activity.
7. Leaf juice is widely used for baldness.
8. LS juice is an excellent remedy for heart problems, digestive and urinary disorders, and in diabetes. LS juice prevents excessive loss of sodium, satiating thirst, and giving a cooling effect.
9. Probably, the bitter principle found in the wild bottle gourds is responsible for the purgative property.
10. Crushed leaves are used for baldness and applied on the head for the headache.
11. Leaves are also used as alternative purgative.

12. Fruit of *Lagenaria siceraria* is rich source of water and minerals and are believed to possess vitamin A, C and B complex.

13. Bottle gourd is believed to help the liver function in a balanced fashion.

14. The juice from the leaves help cure jaundice and the juice from the gourd helps reduce graying of hair.

15. The gourd juice helps treat burning sensation in the urinary passage if consumed with lime juice.

16. It reduces fatigue and keeps you fresh, especially during summer.

17. It helps fight constipation, as it is fiber rich. Because of its fiber and low fat content, Ayurveda highly recommends this food for diabetic patients and young children.

18. Ayurveda also recommends the juice of this gourd in the treatment of acidity, indigestion and ulcers as it serves as an alkaline mixture. Indian traditional medicine claims that bottle gourd acts as a nerve tonic and can help improve obsessive compulsive disorder (OCD). This claim has been confirmed by a study published in the journal Pharmacognosy Research where the investigators found that the plant possesses anti-compulsive (anti-OCD) activity although they are not certain about the mechanism of action of this plant.

19. Bottle gourd is also considered one of the best weight loss foods since it is 96 percent water and provides just 12 calories per 100g of serving.

20. It is rich in, thiamin, vitamin C, zinc, iron and magnesium thus helping in improving overall health.

21. The juice from bottle gourd leaf helps in curing baldness and aids in preventing tooth decay.

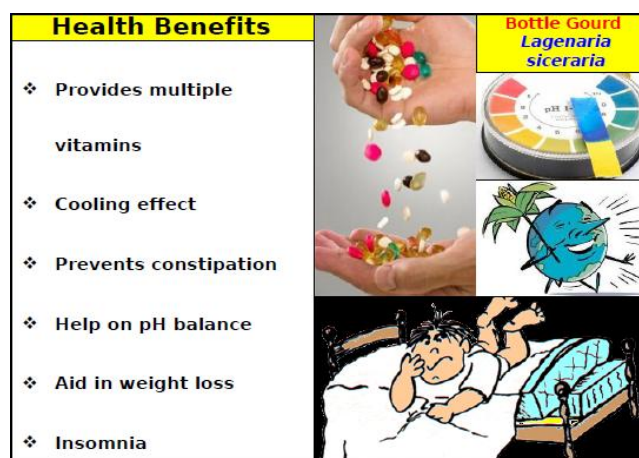


Figure 5:

ADVANTAGES OF BOTTLE GOURD JUICE (*Lagenaria siceraria*):

Bottle gourd, sometimes called the white-flowered or calabash gourd, a delicate nutty flavor, bottle gourd

makes up a staple in Indian cuisine, and it can also be juiced for a nutrient-packed beverage. Bottle gourd juice offers some health benefits, but don't drink bottle gourd juice that tastes bitter -- bitter juice contains toxins that can severely harm your digestive system.

Vitamin C:

Bottle gourd juice serves as a good source of vitamin C. Vitamin C's antioxidant activity shields your cells from damage, preventing the oxidation of DNA that leads to genetic mutations. It also regulates your blood cholesterol levels, plays a role in brain function and helps you make collagen, a protein important for tissue strength. Each cup of bottle gourd juice boasts 26 milligrams of vitamin C. This makes up 29percent of the daily intake for men and 35 percent for women, recommended by the Institute of Medicine.

Zinc:

Bottle gourd juice helps you reach your recommended daily intake of zinc, an essential mineral. Each 1-cup serving of juice provides 1.8 milligrams of zinc -- 23 percent of the recommended daily intake for women and 16 percent for men, according to the Institute of Medicine. Zinc contributes to healthy cell membranes, and also gets incorporated into a range of proteins important for healthy cell function. Some zinc-containing

proteins allow your cells to regulate gene activity, while others aid in cell communication and regulate your body's hormone levels. Zinc also plays a role in nerve health, and zinc deficiencies negatively affect your sense of taste.

Drinking bottle gourd juice might also offer health benefits due to its effect on blood sugar. One animal study performed in rats, published in "Food and Function" in 2011, found that antioxidant-rich juices, including bottle gourd juice, helped to regulate blood sugar after a meal and prevented excessively high blood sugar levels. It also increased the rats' antioxidant levels and prevented harmful tissue oxidation.

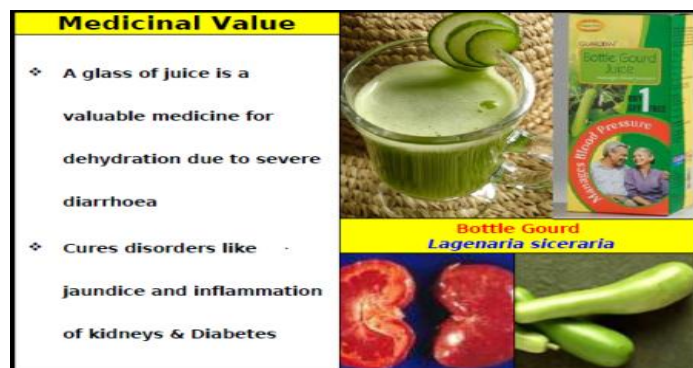


Figure 6:

Table-1 dietary constituents of bottle gourd

S.NO.	CONSTITUENTS	WITH PEEL (g/100g of dry ghiya)	WITHOUT PEEL (g/100g of dry ghiya)
1	Total sugar	5.870	8.290
2	Reducing sugar	5.220	7.920
3	Non-reducing sugar	0.650	0.290
4	Starch	1.310	1.570
5	Curd fiber	4.450	3.400
6	Neutral detergent fiber	22.710	21.160
7	Acid detergent fiber	16.260	15.670
8	Hemi cellulose	6.450	5.580
9	Cellulose	16.070	16.400
10	Lagenin	0.193	0.167

STRANGE FACTS:

1. The bottle gourd is so named because of one of its purposes: To serve as a bowl, cup, or bottle. In other parts of the world, it is known as calabash, lauki, doodhi, ghia, kaddu, tarkari.
2. Bottle gourd is one of the excellent fruits gifted by the nature to human beings having composition of all the essential constituents that are required for good health and quality human life.
3. It helps in losing weight quickly because it is low in fat and cholesterol, and provides high dietary fiber.

4. Traditionally, lauki has been recommended for its anti-diabetic and aphrodisiac properties.
5. The flesh of lauki has a cooling influence on the body.
6. The ghiya juice is used in Ayurvedic medicine to treat high blood pressure and heart problems.
7. Lauki has the highest content of choline (a lipotropic factor), a mental healer and also a precursor of acetylcholine, which is essential for memory than any other vegetable known to man till date.

Precautions: - While it offers benefits due to its nutrient content, bottle gourd juice that tastes bitter poses a

serious health risk. It can cause severe digestive upset, including diarrhea, abdominal pain and vomiting, including vomiting blood, according to a report published in the "Indian Journal of Gastroenterology" in 2011. An additional study, published in the "Indian Journal of Medical Research" in 2012, notes that bitter bottle gourd juice can cause ulcerations throughout your digestive tract, and has even proven fatal. Make sure to pay close attention to the flavor of your bottle gourd juice and seek immediate medical attention if you accidentally consume bitter juice.

CONCLUSION:

Lagenaria siceraria, popularly known as bottle gourd, lauki or ghiya is a climbing plant, which bears hard-shelled and bottle shaped gourds as fruits. *L. siceraria* fruit is cultivated in India, Japan, Sri Lanka, China and Thailand for its kitchen use. Ghiya makes an excellent diet being rich in vitamins, iron and minerals. Lauki has the highest content of choline, which serves as the precursor of neurotransmitter acetylcholine, which in turn is crucial for retaining and enhancing memory, among all the vegetables known to man till date. Furthermore, *Lagenaria siceraria* is a vegetable useful in the management of many diseases like cardiac disorders, hepatic diseases and ulcer. Bottle gourd juice helps to control blood pressure of hypertensive patients, because of its high potassium content. It helps in losing weight quickly, because of its high dietary fiber and low fat and cholesterol content. In the light of above mentioned multiple benefits of bottle gourd, it may be regarded as a natural guard against diseases.

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