

## A review on Pharmacognostical and Pharmacological activities of *Lagenaria Siceraria* species

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**Abstract.** The Cucurbitaceae family consists of about 735 species. The present study includes detailed aspects of species of *Lagenaria siceraria* (Mol.) Standley is a medicinal plant. The plant mainly contains carbohydrates, protein, fats and amino acids. The active constituent of *Lagenaria* is cucurbitacin, lagenin and various mineral matters. In most of the countries *lagenaria* has been used as antioxidant, cardiogenic, liver tonic, anti-inflammatory, diuretic, antihepatotoxic, antitumor, anti HIV, anti proliferative agent. Thus, *lagenaria* posses broad spectrum of pharmacological activities. Moreover, the entire plant and its parts like fruit, fruit pulp, seeds, epicarp etc. shows medicinally important properties. This review article focuses on the pharmacognostic, phytochemistry and pharmacological profile of *Lagenaria*.

### 1. Introduction

*Lagenaria siceraria* (Mol.) Standley is commonly known as bottle-gourd <sup>[1]</sup>. *Lagenaria* is a genus name derived from *lagena*, the Latin word used for Florence flask. The species name *siceraria* refers to the fruit which is useful when it is mature and dry (*siccus*). This plant grows mostly in tropical and subtropical countries <sup>[2]</sup>. The calabash was one of the first cultivated plants, grown not primarily for food, but for use as a water container <sup>[3]</sup>. Bottle gourd is used as vegetable and good source of vitamins B and C <sup>[4]</sup>.

#### 1.1 Species of *Lagenaria siceraria*

The common species of *Lagenaria* includes:

- *Lagenaria siceraria* (Mol) standal.
- *Lagenaria breviflora* (Benth)
- *Lagenaria leucantha*
- *Lagenaria vulgaris*
- *Lagenaria sphaerica*.<sup>[2]</sup>

#### 1.2 Biological Source

Fresh fruits are most widely used. They are obtained from *Lagenaria siceraria* (Molina) belonging to family cucurbitaceae. <sup>[2]</sup> The fruits of *Lagenaria* are shown in figure 1.



**Figure 1: Fruit of *Lagenaria siceraria***

## 2. Morphology

The morphological characters of *Lagenaria* species is discussed below:

**Stem** – The stem is prostrate or climbing in nature with angular, ribbed thick, brittle, softly hairy.

**Leaves** – Leaves are simple with long petiole from 25-30 mm long thick, hallow, densely hairy with two small lateral glands located at the leaf base.

**Leaf lamina**- The lamina of leaf is usually five lobed, broad cordate, pubescent with soft hairs and the tendrils are branched. The flowers are solitary axillary, pedicellate, unisexual and monoecious.

**Petals:** Petals are mainly five, white or cream colored which opens in the evening.

**Fruits:** Fruits are green in color which turns to yellow on maturity. Fruits are large densely hairy often cylindrical or flask shaped or globose. They are constricted at the middle.

**Pulp:** Pulp is pale brown in color and the dried fruit has thick hard hollow structure.

**Seeds:** Seeds are embedded in the spongy pulp and compressed with two flat facial ridges.<sup>(5)</sup>

## 3. Microscopic Characters

The transverse section of *Lagenaria siceraria* leaf showed following features:

**Upper epidermis:** consists of elongated parenchymatous cells, covered by cuticle.

**Lower epidermis:** contains elongated wavy walled parenchymatous cells covered by cuticle.

**Trichomes:** Number of Covering and collapsed trichomes are present, while very few glandular trichomes are also present.

**Stomata:** Upper epidermis shows few stomata, which are of anisocytic type. Palisade cells are present at upper and lower epidermis.

**Mesophyll:** It is made up of 3-4 layered chloroplast containing, compactly arranged, oval to circular cells.

**Vascular bundles:** They are surrounded by 2-3 layered sclerenchyma. They are conjoint, collateral and closed. Xylem is placed towards upper epidermis and phloem towards lower epidermis.<sup>(6)</sup> The microscopy of leaves of *Lagenaria* is shown in figure 2 and 3.



Figure 2: T.S. of *Lagenaria siceraria* leaf

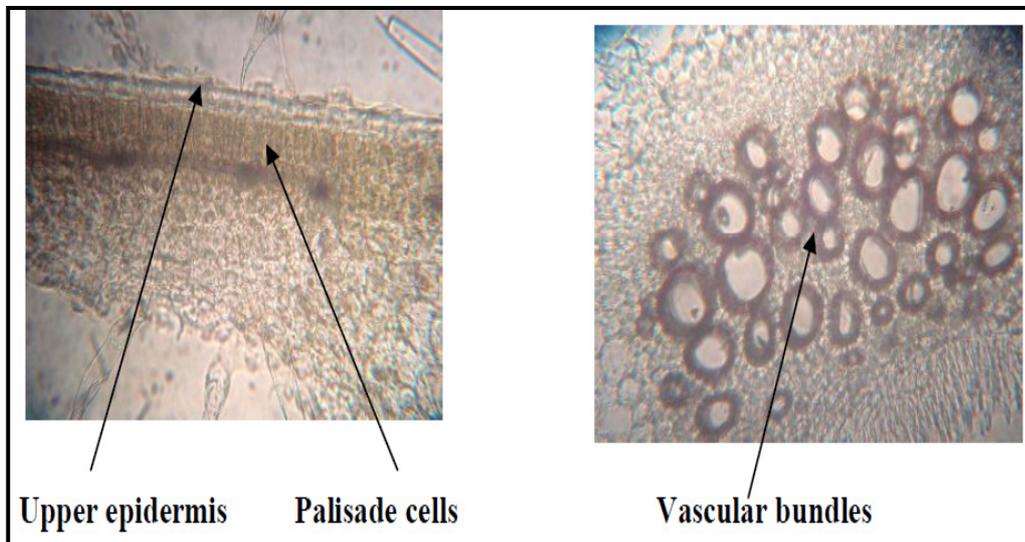


Figure 3: Microscopy of leaves of *Lagenaria*

#### 4. Phytoconstituents

The chief phytoconstituents present in roots, leaves, fruits and seeds are carbohydrates, tannins, flavonoids, proteins, minerals, phytosterols, alkaloids etc. The list of phytoconstituents in various parts of *Lagenaria siceraria* is shown in table no. 1.

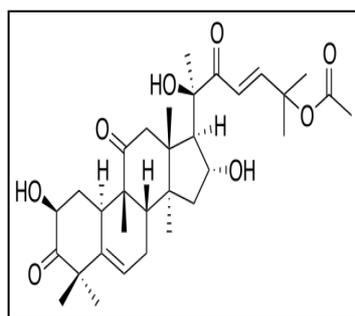
Table 1: Phytoconstituents of *Lagenaria siceraria*

S.No.	Part of Plant	Name of Constituents	Approx. Amount Present
1.		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

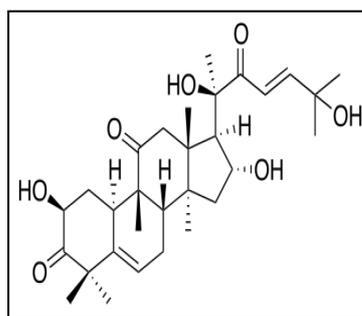
	<b>Fruits<sup>(7)</sup></b>	Phenyl alanine	0.9mg/g
		Valine	0.3mg/g
		Tyrosine	0.4mg/g
		Alanine	0.5mg/g
		Threonine	0.2mg/g
		Glutamic Acid	0.3mg/g
		Serine	0.6mg/g
		Aspartic Acid	1.9mg/g
		Cystine	0.6mg/g
		Arginine	0.4mg/g
		Proline	0.3mg/g
		2.	<b>Seeds<sup>(8)</sup></b>
Carbohydrate	8.3%		
Moisture	2.47%		
Oil	52.54%		
Lagenin	-		
Saponin	-		
3.	<b>Seed oil<sup>(8)</sup></b>	Free Fatty Acids	0.55%
		Linoleic Acid	64.0%
		Oleic Acid	18.3%
		Saturated Fatty Acid	17.8%
		Unsaponified Matter	18.3%
4.	<b>Roots<sup>(8)</sup></b>	Cucurbitacin B	-
		Cucurbitacin D	-
		Cucurbitacin E	-
		Triterpenes	-
		Bryonolic Acid	-
5.	<b>Leaves<sup>(8)</sup></b>	Cucurbitacin B	-
		Carbohydrate	-
		Protein	-
		Phytosterol	-
		Saponin	-
		Amino Acid	-
		Phenolic Compound	-
		Tannins	-
		Flavonoids	-

#### 4.1 Chemical Structure of Some Phytoconstituents

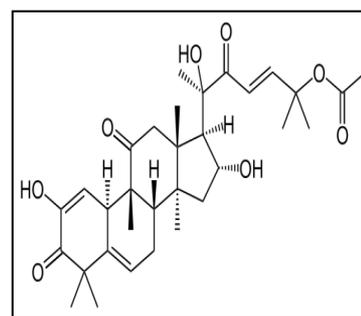
The chemical structure of active constituents Cucurbitacin B, D and E, amino acids valine, Arginine, tyrosine and leucine present in lagenaria species is shown in figure 4.



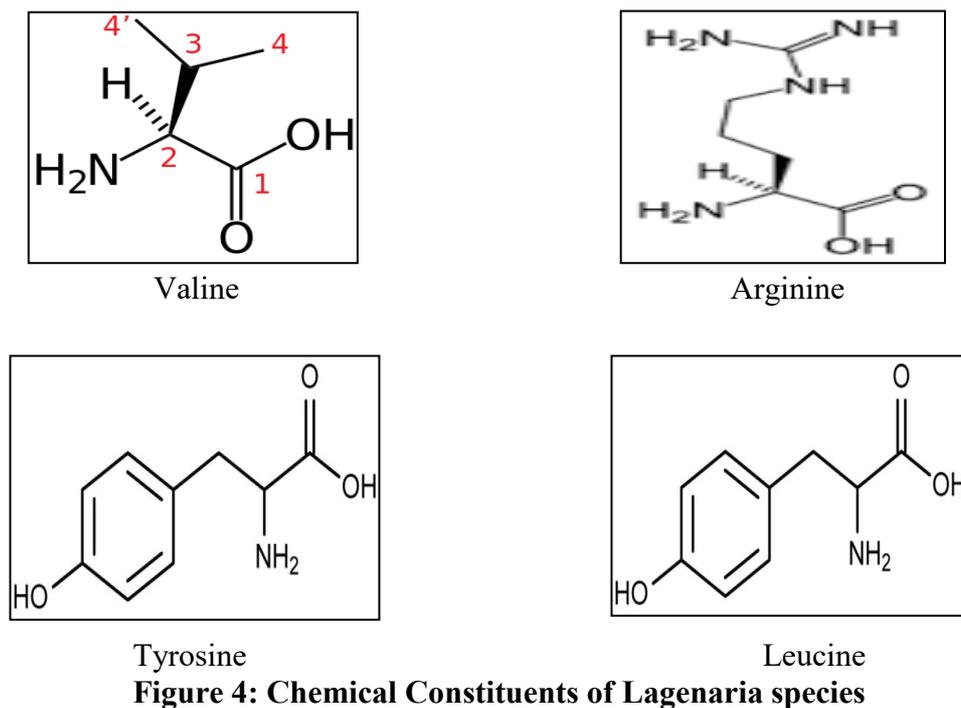
Cucurbitacin B



Cucurbitacin D



Cucurbitacin E



**Figure 4: Chemical Constituents of Lagenaria species**

### 5. Preliminary Phytochemical Screening of fruits of *Lagenaria siceraria*

Based on extensive literature survey, *Lagenaria siceraria* indicated the presence of various constituents which are shown in table no.2

**Table 2: Preliminary Screening of *Lagenaria siceraria* Fruit**

S.No.	Phytoconstituents	Chemical Test	n-hexane Extract	Methanol Extract	n-butanol Extract	Aqueous Extract
1.	Carbohydrate	Molish Test	-ve	+ve	+ve	-ve
2.	Steroids and Triterpenoids	Liebermann Burchard Test	+ve	+ve	+ve	+ve
3.	Anthraquinones	Bortrager Test	-ve	-ve	-ve	+ve
4.	Flavones	Shinoda Test	-ve	-ve	-ve	+ve
5.	Alkaloids	Dragendorff Test	-ve	-ve	-ve	+ve
6.	Tannins <sup>(9)</sup>	Ferric Chloride Test	-ve	-ve	-ve	+ve

### 6. Phytochemical Evaluation

Parameter	Range
<b>Extractive Value</b>	
Methanol extract	5 - 5.5 %w/w
Aqueous extract	4 - 4.5 %w/w
<b>Loss on drying</b>	4- 4.5 %w/w
<b>Ash values</b>	
Total ash	90 - 92 %w/w
Acid insoluble ash	0.10 - 0.80 %w/w
Water soluble ash	3.2 - 4.0 %w/w <sup>(10)</sup>

### 7. Uses

The entire plant and various parts of *Lagenaria siceraria* species have medicinally important properties. These are discussed in table no.3.

**Table 4: Uses of various parts of *Lagenaria siceraria***

S. No	Part of Plant	Uses
1.	Fruit	Cardiotonic, Anti-inflammatory, Liver Tonic, Diuretic <sup>(10)</sup>
2.	Seed	Antitumor, Anti HIV, Antiviral, Antiproliferative <sup>(11)</sup>
3.	Fruit Pulp	Antihepatotoxic activity <sup>(12)</sup>
4.	Fruit Juice	Analgesic, Anti-inflammatory <sup>(12)</sup> , Antioxidant <sup>(12)</sup>
6.	Epicarp	Antioxidant <sup>(12)</sup>

## 8. Pharmacological Activities

As reported in literature, *lagenaria* species possess broad spectrum of biological activities. These activities are discussed as under:

### 8.1 Analgesic and anti-inflammatory activity

Analgesic and anti-inflammatory effects of *Lagenaria* fruit juice extract were evaluated in rats and mice. The juice extract was investigated for its analgesic effect on acetic acid induced writhing and formalin pain tests in mice. Anti-inflammatory effects were studied employing acute inflammatory models, i.e., ethyl phenyl propionate induced ear edema, carrageenan and arachidonic acid induced hind paw edema, and also the albumin-induced paw edema in rats.<sup>(13)</sup>

### 8.2 Anti hyperlipidemic activity

Anti hyperlipidemic activity of the fruit extracts was investigated in triton-induced hyperlipidemic rats and hypolipidemic effect in normocholesteremic rats. Four different extracts viz. petroleum ether, chloroform, alcoholic, and aqueous extracts were prepared. Dose dependently oral administration of the extracts inhibited the total cholesterol, triglycerides, low-density lipoproteins level, and significantly increased the high-density lipoproteins level. Both the chloroform and alcoholic extracts exhibited significant effects as compared to others.<sup>(13)</sup>

### 8.3 Diuretic activity

Diuretic activity of vacuum dried juice extract and methanol extract of the fruits was studied in albino rats. Different parameters such as total urine volume, urine concentration of electrolytes such as sodium, potassium, and chloride were evaluated. Rats treated with methanol extract and vacuum dried juice extract (100 -200 mg/kg; p.o.) showed higher urine volume compared to control. Both juice and methanol extract exhibited dose-dependent increase in the excretion of electrolytes in comparison to controls. The elevated diuretic potentials of juice and methanol extract were compared to that of the standard diuretic agent furosemide (20 mg/kg; i.p.).<sup>(13)</sup>

### 8.4 Anthelmintic activity

*Lagenaria* seeds showed *in vitro* anthelmintic activity against *Pheretima posthuma*. According to the study, various concentrations (10 -100 mg/ml) of seed extracts were tested in the bioassay, which involved determination of time of paralysis and time of death of the worms. Piperazine citrate (10 mg/ml) was used as standard reference and distilled water as control. All the extracts, those using methanol and benzene showed significant paralysis, and also caused death of worms especially at the higher concentration of 100 mg/ml, compared to standard.<sup>(13)</sup>

### 8.5 Antihepatotoxic activity

Antihepatotoxic activity of different fractions of the ethanolic extract of the fruit was investigated by oral administration to different groups of rats using the CCl<sub>4</sub>-induced hepatotoxicity test. During the study, each fraction showed significant activity at dose of 250 mg/kg. Of all fractions, those in petroleum ether exhibited a comparatively higher activity.<sup>(13)</sup>

### 8.6 Immunomodulatory activity

Immunomodulatory effects of n-butanol soluble and ethyl acetate soluble fractions of methanolic extracts of the fruits were investigated in rats. Oral administration at dose of 100 -500 mg/kg inhibited delayed-type hypersensitivity reaction in rats. A dose-dependent increase in both primary and secondary antibody titer was evaluated. Fractions also increased both white blood cell and lymphocyte count.<sup>(13)</sup>

### 8.7 Anti stress and adaptogenic property

The anti stress potential of ethanolic extracts of fruits in albino Wistar rats were evaluated and investigated the influence of forced swimming endurance stress on swimming endurance time, organ weights, and changes in biochemical parameters in rats. Author investigated the acute heat stress induced changes in biochemical parameters, adrenal gland weight, and stress-induced perturbations in blood cell counts in rats. *Withania somnifera* was used as standard.<sup>(13)</sup>

### 8.8 Hepatoprotective activity

Lakshmi BVS, et al investigated the hepatoprotective activity of *Lagenaria siceraria* fruit extracts against carbon tetrachloride (CCl<sub>4</sub>) induced hepatotoxicity on rats. Hepatotoxicity induced in male Wistar rats by Intraperitoneal injection of CCl<sub>4</sub> (1 ml/kg/day for 7 days). The ethanolic extracts of *Lagenaria siceraria* juice extract (LSJE) were administered to the rats (400 mg/kg/day, p.o. for 10 days). The hepatoprotective effect of extracts were evaluated by the assay of liver function biochemical parameters (total bilirubin, serum protein, alanine aminotransaminase, aspartate aminotransaminase, and alkaline phosphatase activities), liver weight and histopathological studies of the liver.<sup>(14)</sup>

### 8.9 Antioxidant activity

Acetone extract of fruit epicarp of *Lagenaria Siceraria* fruit showed highest antioxidant activity against in vitro model using DPPH (1, 1- diphenyl-2-picryl hydrazyl). The fresh juice of the fruit also shows antioxidant activity. The juice and its ten times dilution showed radical scavenging activity.<sup>(14)</sup>

### 8.10 Cardioprotective activity

M Hassanpur Fard et al. investigate the cardioprotective activity of *Lagenaria siceraria* fruit powder rat. Wistar albino rats (250- 300 gm) were divided in three groups. The drug was evaluated against Doxorubicin induced cardiotoxicity at 200 mg/kg, p.o for 18 days. *Lagenaria Siceraria* prevents the alteration in endogenous antioxidants (superoxide dismutase, reduced glutathione) and lipid peroxidation whereas markers of cardiotoxicity i.e. CK-MB (Creatine kinase) and LDH (lactate dehydrogenase) were significantly reduced. Further the *Lagenaria Siceraria* powder also showed the protection against changes in ECG and histopathological alteration induced by doxorubicin.<sup>(14)</sup>

### 8.11 Anti hyperglycemic activity

Anti hyperglycemic activity of methanol extract of *Lagenaria siceraria* aerial parts (MELS) use in diabetes has been reported. Streptozotocin (50 mg/kg, i.p.) was induced Hyperglycemia in rats. Treatment was studied by MELS at doses of 200 and 400 mg/kg, p.o. for 14 days. As a reference drug Glibenclamide (500 µg/kg) was used. Anti hyperglycemic potential was evaluated 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.<sup>(14)</sup>

### 8.12 Anticancer activity

Anticancer activity of methanol extract of *Lagenaria siceraria* aerial parts has been investigated on Ehrlich's Ascites Carcinoma (EAC) model in mice. After EAC cells inoculation 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 studied by the tumor growth response including increasing in life span, study of haematological parameters biochemical estimation and antioxidant assay of liver tissue. Experimental results showed that *L. siceraria* posses significant anticancer activity which may be due to its cytotoxicity and antioxidant properties.<sup>(14)</sup>

### 8.13 Antidepressant activity

Prajapati R. et al studied the antidepressant activity of methanolic extract of *Lagenaria siceraria* fruits using forced swim model. *Lagenaria* fruit were dried and extracted with methanol in soxhlet apparatus for 5-6 hours. Male Wistar albino rats (250-300 gm) were evaluated to behavior despair test. Imipramine was used as a standard drug.<sup>(14)</sup>

## 9. Literature Review of *Lagenaria siceraria*

On the basis of extensive literature review, the detailed pharmacological activities are highlighted below:

1. Singh M. K. et al; 2012 evaluated the combined effect of simvastatin(SIM) and hydro-alcoholic seed extract of *Lagenaria siceraria* (H.L.S.S.E.) in doxorubicin (DOX) induced cardio-toxicity in Wister rats.<sup>(15)</sup>
2. Ghule BV et al; 2006: studied. Hypolipidemic and antihyperlipidemic effects of *Lagenaria siceraria* (Mol.) fruit extracts.<sup>(16)</sup>
3. Han JS et al ; 2005 reported the agrobacterium-mediated transformation of bottle gourd (*Lagenaria siceraria* Standl).<sup>(17)</sup>
4. Somshuvra Bhattacharya et al; 2012 evaluated the possible anti-diabetic potential of *Lagenaria siceraria* seed extract (LSSE) and *Lagenaria siceraria* pulp extract (LSPE) against the pancreatic damage from alloxan induced diabetes in rats related to diabetes mellitus.<sup>(18)</sup>
5. Chinmoy Kumar Sen et al; 2013 studied the n-haxane extract of flowers of *Lagenaria siceraria* shows antitumor properties using brine shrimp lethality bioassay.<sup>(19)</sup>
6. HX et al; 2000 investigated the Lagenin, a novel ribosome-inactivating Wang with protein ribonucleolytic activity from bottle gourd (*Lagenaria siceraria*) seeds.<sup>(20)</sup>
7. Ojiako OA et al; 2007 Studied the nutritional and anti-nutritional compositions of *Cleome ruidosperma*, *Lagenaria siceraria*, and *Cucurbita maxima* seeds from nigeria.<sup>(21)</sup>
8. Sokoto M.A. et al; 2013 studied the production, physicochemical characterization and optimization of biodiesel from seed oil of *Lagenaria vulgaris* (calabash). Oil was extracted from seeds with n-hexane, then transesterified using single step alkali hydrolysis or biodiesel.<sup>(22)</sup>
9. Joshi Padmashree et al; 2013 studied the antioxidant activity of decoctions and fresh juice sample of raw fruit parts of *Lagenaria siceraria*.<sup>(23)</sup>
10. Elhadi Mohamed Ihsan et al; 2013 evaluate the anti-giardial activity of *Cucurbita maxima* D, *Cucurbita pepo* L, and *Lagenaria siceraria*.<sup>(24)</sup>
11. Emmanuel E. Essien et al; 2013 studied the physicochemical properties and fatty acid compositional patterns of seed oil corresponding to ten cultivars of *L. siceraria*.<sup>(25)</sup>

## 10. Conclusion

The present article discusses the medicinal properties of *L. siceraria* which are used in the treatment of different diseases as pain, asthma, fever, ulcer etc. Also cucurbitacin, linoleic acid, oleic acid, phytosterol, phenolic compound etc the active constituents are useful to overcome therapeutic complications. Moreover, such work of detailed report about *Lagenaria* species is not available in literatures. In future it would be possible to isolate the active constituent present in various parts of the plant through column chromatography and evaluate its ex-vivo potentials. Also, in-vivo study based on animal models will help to explore the hidden pharmacological activities of *Lagenaria*.

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