



## A Review on Ethnomedicinal Uses and Biological activities of *Luffa acutangula*

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### ABSTRACT

Nature has been a source of medicinal agents for thousands of years, which formed the basis of health care all over the world since the earliest days of mankind. *Luffa acutangula* is a popular vegetable in India and other Asian countries. It contains many phytochemicals such as flavonoids, saponins, luffangulin, sapogenin, oleanolic acid and Cucurbitacin B. *Luffa acutangula* traditionally has been used as diuretic, expectorant, laxative, purgative, hypoglycemic agent and bitter tonic. The ethno botanical survey revealed its use to protect jaundice, insect bites, dysentery and headache. This article was designed with an intention to provide complete review of Pharmacology and ethnomedicinal uses of *Luffa acutangula*. The fruits, seeds and plant extracts have been used as anti-diabetic, hepatoprotective, antioxidant, antimicrobial, anticancer, antiulcer, CNS depressant etc. The intention of this article is to focus on variety of pharmacological uses of *Luffa acutangula*. The present review is based on the areas which are needed to have immediate attention for preparation of herbal drugs based on the pharmacological evidences.

**Keywords:** *L. acutangula*, Ethnomedicinal Phytochemistry, Anti-diabetic, Antioxidant, Antimicrobial, Antiulcer, CNS depressant.

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### Taxonomical classification

Kingdom	-	Plantae
Division	-	Magnoliophyta
Class	-	Magnoliopsida
Order	-	Cucurbitales
Family	-	Cucurbitaceae
Genus	-	<i>Luffa</i>
Species	-	<i>acutangula</i>

### INTRODUCTION

Plants have been used for treating various ailments from the pre historic times and continue to be the source of more than 25% of the modern prescribed drugs. In the indigenous medicine, all over the world, for 2000 years, plants have been used against many kinds of diseases.

One such plant, *Luffa acutangula*, (Family- Cucurbitaceae), commonly known as Ridge gourd and trio, is a large monoecious, annual climber, found wild and also cultivated throughout the greater parts of India.<sup>1</sup> It contains crystalline bitter principle similar to cucurbitacin B, luffin, and colocynths.<sup>2</sup>

The entire plant of *Luffa acutangula* L. is medicinally important and is used extensively in Indian traditional system of medicines<sup>3</sup>. Various biological activities of this plant were reported including hepatoprotective activity, anti-diabetic activity, antioxidant activity, fungi static property, CNS depressant activity etc.<sup>4-7</sup>



Figure 1: *Luffa acutangula*

**DESCRIPTION<sup>6</sup>**

*Luffa acutangula* is a climber.

**Roots:** Roots of *Luffa acutangula* plants are yellowish-Brown in colour, almost cylindrical in shape, having 8-12cm length and 0.7cm thickness. They are rough in touch because of longitudinal wrinkles and also showed new adventitious roots.

**Stems:** It is with 5 angled glabrous stem and 3-fid tendrils.

**Leaves:** Leaves of *Luffa acutangula* are orbicular in outline with the length 15-20 cm long, palmately 5-7 angled or sublobate, scabrid. Veins and vein let are prominent.

**Fruits:** The fruits are ovate, pale yellowish brown in color with 4-10 cm long, 2-4cm broad and outer surface being covered with 8 -10 prominent longitudinal ribs. It is tapering towards the base and longitudinally ribbed. The fruits are divided into 3 chambers. The inner part is fibrous in nature and easily detachable as a whole from the outer part. Taste is bitter. Transverse section of fruit through a rib shows a single layer of papillose epidermis covered with thick striated cuticle, followed by 4-6 layers of parenchymatous cells.

**Seeds:** Seeds are black in colored with bitter taste and having ovoid- oblong shape. The length is generally 0.6-0.8cm with width of 0.5-0.6cm.

**Distribution:** *Luffa acutangula* cultivated throughout India as it is pan tropic.

**Habit:** Herb. Propagation: Propagation of *L.acutangula* is by seeds.

**Native range:** India and Naturalized throughout the moister Tropics.

**Ethnopharmacology**

Ethnomedico survey of hilly areas in Maharashtra revealed that fine powder of fruits of *Luffa acutangula* is used in protection from jaundice when taken in the form of very fine powder through nose. Ancient literature revealed that the plant has significant use as abortifacient and antifungal agent<sup>8</sup>.

As per folk lore claims, whole plant is useful in treating jaundice, tetanus, vomiting, insanity and itches.<sup>9</sup>

1. *Luffa acutangula* has diuretic properties.
2. It is used as an expectorant and anti-hyperglycaemic.
3. It is used as bitter tonic.
4. It is used to reduce hyper acidity.
5. The leaves of *Luffa acutangula* found useful in the treatment of dysentery.
6. The leaves or juice of *Luffa acutangula* are used as dressing in the diseases like Inflammation of spleen, Ring worms, Piles, and even in Leprosy.

7. Pounded leaves after mixing with garlic are applied locally for relief in Leprosy.

8. The roots of *Luffa acutangula* added to milk or water is helpful for removal of kidney Stone.

9. Roots of *Luffa acutangula*, boiled in hot water and applied on skin is used to treat the swelling of the lymph glands.

10. Oil, extracted from the seeds of *Luffa acutangula* is used in the treatment of skin diseases.

11. *Luffa acutangula* is an effective home remedy for the prevention of premature greying of hair.

12. *Luffa acutangula* Fruit with ribbed skin is sun dried and used to prevent the premature greying of hair.<sup>10</sup>

**Standards**

Studies conducted on identity, purity and strength of *Luffa acutangula* revealed that it contains.<sup>11,12</sup>

1. Total ash content not more than 16%
2. Foreign matter not more than 2%
3. Acid-insoluble ash not more than 4%
4. Water soluble extract not more than 13%
5. Alcohols soluble extract not more than 6%

**Hepatoprotective**

Hepatoprotective potential of the alcoholic extract of fruits of the plant *Luffa acutangula* was studied *in vivo* in rats as well as *ex vivo* in isolated hepatocytes against paracetamol induced hepatotoxicity. The hepatoprotective activity was determined on the basis of the effects on parameters such as direct bilirubin, serum aspartate transaminase, serum alanine transaminase and alkaline phosphatase. Ethyl acetate fraction (EAF) of *L. acutangula* fruit alcoholic extract (100 mg/kg) exhibited maximum hepatoprotective activity.<sup>13</sup>

Hepatoprotective activity of hydro-alcoholic extract of fruits of *Luffa acutangula* (HAELA) using carbon tetrachloride and rifampicin induced liver damage in wistar albino rats was studied. Standard drug used was silymarin. Study revealed that extract significantly reduced levels of serum marker enzymes (AST, ALT, ALP and LDH). These biochemical observations were supplemented by histopathological examination of liver sections which showed increased total protein levels including the improvement in histoarchitecture of liver cells of the targeted groups in comparison to the control group. HAELA also showed significant decrease in malondialdehyde (MDA) formation, increased activity of non-enzymatic intracellular antioxidant, glutathione and enzymatic antioxidants, catalase and superoxide dismutase. The present findings suggest that hydro alcoholic extract of the fruits of *L. acutangula* possess potential hepatoprotective activity due to endogenous antioxidants and inhibition of lipid peroxidation of membrane.<sup>14</sup>



Saponin fraction of *Luffa acutangula* seeds was investigated for hepatoprotective activity in CCl<sub>4</sub> induced liver fibrocystic rats. Male Wistar rats were divided into six groups-normal group, control group, standard group and three test groups, treated with saponin fraction of *Luffa acutangula*. The study concluded the dose dependent hepato-protection since administration of saponin fraction, at dose 10 mg/kg body weight twice a week, 20 mg/kg body weight twice a week and 20mg/kg body weight once daily showed hepatoprotective activity and the highest effect was observed at the dose of 20 mg/kg body weight once daily.<sup>15,16</sup>

Hepatoprotective activity of *Luffa acutangula* fruits extracts was studied against carbon tetrachloride (1ml/kg) induced hepatotoxicity in rats. Alcoholic extract (150mg/kg) of *Luffa acutangula* showed good hepatoprotective activity, while petroleum extract (150mg/kg) showed moderate hepatoprotective activity, compared with standard drug silymarin (100mg/kg). Thus, the present study concluded that ethanolic fruit extract of *Luffa acutangula* possess a good hepatoprotective activity, which might be due to antioxidant properties.<sup>17,18</sup>

#### Antidiabetic Activity

A comparative study of leaves of *Grewia asiatica*, fruits of *Luffa acutangula* and bark of *Bombax ceiba* using ether, chloroform, ethanolic and aqueous extracts at the dose of 200 mg/kg b.w. on alloxan induced diabetic wistar rats have been conducted for screening of anti-diabetic activity. Among all extracts, chloroform and alcoholic extracts of fruits of *Luffa acutangula* has reported more significant ( $p < 0.01$ ) reduction in blood glucose level in alloxan induced diabetic Wistar rats compared to control. Glibenclamide at 10mg/kg b.w. was used as standard drug.<sup>19,20,21</sup>

#### Antihyperglycemic

Antihyperglycemic activity was evaluated through oral glucose tolerance tests in glucose-loaded mice. In antihyperglycemic activity tests conducted with glucose-loaded Swiss albino mice, methanolic extract of fruits significantly and dose-dependently reduced blood sugar concentrations. At extract doses of 100, 200 and 400 mg per kg body weight mice, the percent lowering of blood sugar by the extract was, respectively, 38.5, 39.6, and 41.8. The results were both dose-dependent and statistically significant. At a lower extract dose of 50 mg per kg body weight, the extract reduced blood sugar concentrations by 13.1%, but the results were not statistically significant. A standard antihyperglycemic drug, glibenclamide, when administered to glucose-loaded mice at a dose of 10 mg per kg body weight, reduced blood sugar levels by 41.3%. The results demonstrate that the methanolic extract possesses antihyperglycemic potential.<sup>21,23</sup>

#### Antiproliferative

The study was designed to evaluate the in-vitro antiproliferative activity of *Luffa acutangula* against

human non-small cell lung cancer cell line (NCI-H460). Induction of apoptosis and reactive oxygen species (ROS) generation was determined through fluorescence microscopic technique. Quantitative real-time PCR and western blotting analysis was carried out to detect the expression of pro-apoptotic (p53, p21, caspase-3, GADD45A, and ATM) and anti-apoptotic (NF- $\kappa$ B) proteins in NCI-H460 cell line.

The DHMA inhibited the cell viability of NCI-H460 cells in a dose-dependent manner with an IC<sub>50</sub> of about 50  $\mu$ g/ml. It significantly reduced cell viability correlated with induction of apoptosis, which was associated with ROS generation. The apoptotic cell death was further confirmed through dual staining and DNA fragmentation assay. DHMA significantly increased the expression of anti-apoptotic protein such as p53, p21, Bax, and caspase-3 but down regulated the expression of NF- $\kappa$ B in NCI-H460 cell line. In silico studies demonstrate that DHMA formed hydrogen bond interaction with key residues Trp26, Phe55 and Lys24 by which it disrupts the binding of p53 with MDM2 receptor. These findings suggested that DHMA induces apoptosis in NCI-H460 via a p53-dependent pathway. This the first study on cytotoxic and apoptosis inducing activity of DHMA from *L. acutangula* against NCI-H460 cell line. Therefore, DHMA has therapeutic potential for lung cancer treatment.<sup>20</sup>

The present study was undertaken to evaluate the possibility of *Luffa acutangula* (cucurbitaceous family) fruit as a potential anticancer agent by examining antiproliferative and antiangiogenic activities. Fruit methanolic extract showed significant antiproliferative activity (IC<sub>50</sub>, 131.63 $\pm$ 2.31  $\mu$ g/ml) on human lung adenocarcinoma epithelial cell line (A-549). The extract was partially purified by chromatography. Fraction F2-3 showed most potent antiproliferative activity (IC<sub>50</sub>, 7.61 $\pm$ 1.03  $\mu$ g/ml) and was further evaluated for antiangiogenic activity by evaluating vascular endothelial growth factor (VEGF), matrix metalloproteinases-2 (MMP-2) and matrix metalloproteinases-9 (MMP-9) as in-vitro, chick chorioallantoic membrane (CAM) as an in-vivo model for VEGF. VEGF and both MMP protein expressions were significantly inhibited in F2-3 treated A-549 cells compared to control cells (VEGF: 4.36 $\pm$ 0.47 and 14 $\pm$ 0.75 pg/ml, MMP-2: 10.17 $\pm$ 1.3 and 20.28 $\pm$ 1.68, MMP-9: 12.93 $\pm$ 1.70 and 21.12 $\pm$ 2.12 ng/ml, respectively).<sup>23,25</sup>

#### Antioxygenic

Powder of *Luffa acutangula* pulp and peel, as well as their various fractions were evaluated for antioxygenic activity by using different methods. Ridge gourd pulp and peel powders and their ethanol/water extracts exhibited strong antioxygenic activity in sunflower oil. The water extracts devoid of any antioxygenic activity in sunflower oil. Ridge gourd pulp and peel powders as well as their extracts were evaluated for their antioxygenic activity using linoleic acid peroxidation,  $\beta$ -carotene-linoleic acid bleaching and DPPH methods.



Ethanol/water extracts from ridge gourd pulp and peel showed highest antioxygenic activity followed by water extracts, while the petroleum ether extract showed moderate antioxygenic activity. Ridge gourd peel powder and its extracts showed slightly higher antioxygenic activity than ridge gourd pulp powder and its extracts. This may be attributed to the presence of higher amounts of phenolics and flavonoids which have been reported as potential antioxidants.<sup>23, 24, 26</sup>

### CNS Depressant Activity and Cerebro-protective Effects

The study of evaluation of protective effect of *Luffa acutangula* extract against bilateral carotid artery occlusion (BCAO) induced stroke in rats by Sathianarayanan. S (Oct, 2012) confirmed that ELA protects rats from ischemia induced brain injury. This protection was manifest from in-vivo behavioural tests. Petroleum ether extracts of Whole plant of *Luffa acutangula* produced cerebroprotective effects in global cerebral ischemia as evident from reduction in behaviour pattern, hyper locomotion and neuronal damage<sup>2</sup>. The allied species of *Luffa echinate* Roxb has reported to possess CNS depressant activity and alkaloid isolated from it acts as important local anesthetic and antispasmodic action. On this basis A.V. Misar (2004) studied the CNS depressant activity of the ethanolic extract of LA fruit in mice. The extract shows the effect on behavioural changes, exploratory activity, and barbiturate sleeping time in mice. The extract exhibited dose-dependent CNS depressant activity.<sup>3</sup>

**Table 1:** Pharmacological activities of *Luffa acutangula*<sup>16, 19, 21, 24, 22</sup>

S. No.	Parts studied	Biological activity
1	Saponin fraction of <i>L. Acutangula</i> seeds Ethanolic fruit extracts of <i>L. acutangula</i>	Hepatoprotective activity
2	Methanolic and aqueous extracts of fruit of <i>L. acutangula</i>	Anti-ulcer activity
3	Ethanolic and aqueous extracts of <i>L. acutangula</i>	Anti-cancer
4	Ethanolic extract of <i>L.acutangula</i> fruits	CNS depressant activity
5	Seeds of <i>L. acutangula</i>	Fungistatic property
6	Ethanolic extract of fruit of <i>L. acutangula</i>	Analgesic activity
7	Fruit extract of <i>L. acutangula</i> Methanolic and aqueous extracts of <i>L. acutangula</i>	Antimicrobial activity
8	Aerial parts of <i>L. acutangula</i>	Larvicidal activity
9	Ethanolic extracts of Pericarp of <i>L. acutangula</i>	Immuno-modulatory activity

### CONCLUSION

This review has exposed that *Luffa acutangula* has hepatoprotective, anti-diabetic, antiulcer, antiproliferative and antiangiogenic, anticancer, antioxidant, CNS depressant, fungi static, anticataleptic, analgesic, antimicrobial, larvicidal and immunomodulatory activity.

Ethno-botanical and folklore claims indicated its traditional use in indigenous and traditional medicinal systems of India. *Luffa acutangula* contains proven medicinal importance. Further, studies should also be focused on bioactive principles of *L. acutangula* which are responsible for the health benefits, so that the bioactive compounds could give some leads for new drug discovery to various chronic diseases.

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