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LUFFA ACUTANGULA (LINN.) ROXB. VAR. AMARA *(ROXB.)* A CONSENSUS REVIEW

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ABSTRACT

Nature has been a source of medicinal agents for thousands of years, herbal medicines which formed the basis of health care throughout the world since the earliest days of mankind are still widely used. *Luffa acutangula* is widely growing vegetative climber and is used traditionally in folklore medicines for ailments including jaundice, diabetes, liver diseases, skin diseases, wounds etc. Taking into consideration, its medicinal importance and taxonomic confusion, exhaustive study of the morphology, tissue culture, phytochemical constituents, ethnobotany and biological activities of *Luffa acutangula var. amara* Roxb. fruits is carried out which will provide useful information in regard to its correct identity and help to differentiate from the closely related otherspecies of *Luffa*.

KEYWORDS: ***Luffa acutangula*, morphology, tissue culture, diabetes, review.**

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INTRODUCTION

Plants have been in use for treating various ailments from the pre historic times and continue to be the source of more than 25% of the present range of prescribed drugs. In the indigenous medicine, all over the world, for 2000 years, plants have been used against many kinds of diseases. The earliest record of herbal treatment can be traced to ancient Chinese and Greek texts. Unani and Ayurvedic systems also used a large number of plants for various diseases. One such plant, *Luffa acutangula,* (Family: Cucurbitaceae), commonly known as Ridge gourd and tiroi, is a large monoecious, annual climber, found wild and also cultivated throughout the greater parts of India.It contains crystalline bitter principle similar to cucurbitacin B, luffin, and colocynthin[1].Seeds show presence of saturated and unsaturated fatty acid palmatic, stearic, oleic, linoleic and traces of lignoceric acid while fruits contain cucurbitacin B, E and oleanalic acid[2].Leaves of this plant are orbicular, pale green in colour and fruits are baseball club shaped. The plant possesses laxative and purgative property and ethno medico survey of hilly areas in Maharashtra revealed that fruits of *Luffa acutangula* are used in protection from jaundice when taken in the form of very fine powder through nose[3]while the seeds possess emetic, expectorant, and demulcent property[4].The ancient literature also revealed that the plant is significantly used as abortifacient and antifungal agent[5]. In context with the important phytochemical and therapeutic findings, in this review, a comprehensive account of morphology, tissueculture, phytochemistry, ehthnomedicinal uses and pharmacological activities are included for further exploring its pharmacological potential.

HIERARCHY OF LUFFA ACUTANGULA

Kingdom : Plantae
Division : Magnoliophyta
Class : Magnoliopsida
Order : Cucurbitales
Family : Cucurbitaceae
Genus : *Luffa*
Species : *acutangula*

VERNACULAR NAMES[6]

Sanskrit : Gantali, Kosataki, and Ksweda.
Bengali : Zinga
English : Ribbed Gourd
Gujarati : Turiya, Kadawa, Turiya
Hindi : Turai, Satputia
Kannada : Hire-Valli
Malayalam : Peerkam Kai
Marathi : Dodka Turiya
Punjabi : Turiya
Tamil : Peerkku
Telugu : Beera, Chedu beeha, Varri beera
Urdu : Turai

GROWTH & DISTRIBUTION

The *Luffa acutangula* Linn. Var. *amara* Roxb.is a large monoeious annual climber. It is indigenous to Western, Central and Southern regions of India, and regarded as wild variety ofcultivated species. It resembles to *Luffa acutangula* in every aspects, except that it has smaller leaves, flower, fruits and seeds[7].

MORPHOLOGY[6]

a. Root- Roots are yellowish-brown in colour, almost cylindrical in shape, having 8-12 cm

length and 0.5-0.7 cm thickness. They are rough in touch because of longitudinal wrinkles and also showed presence of few adventitious roots.

b. **Stem**-Stem is brownish-yellow in colour, 0.2-0.4 cm thick, 5 angled, glabrous, and consists of tendrils.
c. **Leaf** - Petiole is brownish yellow coloured, 3-8 cm in length; somewhat twisted, wrinkled and angular while lamina having pale or light-green colour, 6-9 cm long, crimpled and broad.
d. **Flower** - Male flower is 1.3 cm long, light greenish-yellow coloured, occurs in small racemes having pubescent calyx and lanceolate lobes. Three stamens are present and corolla is yellow in colour whereas female flower is solitary, yellow coloured having 5-10 cm long pedicel. Ovary is strongly ribbed and trifid stigma is present.
e. **Fruit** - Fruits are obovate, cylindrical or club-shaped, pale yellowish-brown in colour having 9-12 cm length and 2-4 cm width. These are tapering towards the base and covered with 8-10prominent longitudinal ribs on outer surface. There are three chambers, of which inner part is fibrous and easily detachable from outer one.
f. **Seed -**Seeds are black coloured, bitter in taste, having ovoid-oblong shape. The length is generally 0.6-0.8 cm with width of 0.5-0.6 cm.

Figure 1 ***Leaves of Luffa acutangula***
Figure 2 ***Fruit of Luffa acutangula***
Figure 3 ***Seeds of Luffa acutangula***

MICROSCOPY[6]

a. **Root**–Transverse section of root shows presence of cork cells, disintegrated cortex and large, thin walled, lignified stone cells. Secondary phloem consisting of thin walled cells of usual elements and secondary xylem tissues are lignified traversed by multiseriate, radially elongated, thin-walled ray cell; round to oval starch grains measuring 4-7 µ in diameter are present and distincthilum is found in secondary cortex.
b. **Stem**–Stem shows 5 prominent ridges, single layered epidermis covered by cuticle and cortex composed of 6 -10 or more layered, oval to polygonal, collenchyma cells under ridges, followed by 4-6 layered, compact band of thick-walled, polygonal, lignified cells; ground tissues composed of round to oval, thin-walled, parenchymatous cells, embedded with 10 bicollateral, open, conjoint, endarch vascular bundles, 5 of outer ring present opposite the ridges while rest 5 of the inner ring face the furrows.
c. **Leaf**-Petiole shows 6-7 prominent ridges having single layered epidermis, covered by thick cuticle; secondary cortex is wide in each ridge, composed of thin-walled, parenchymatous cells. Lamina shows single layered epidermis on both surfaces, having simple unicellular hairs with blunt tips and glandular hairs with unicellular

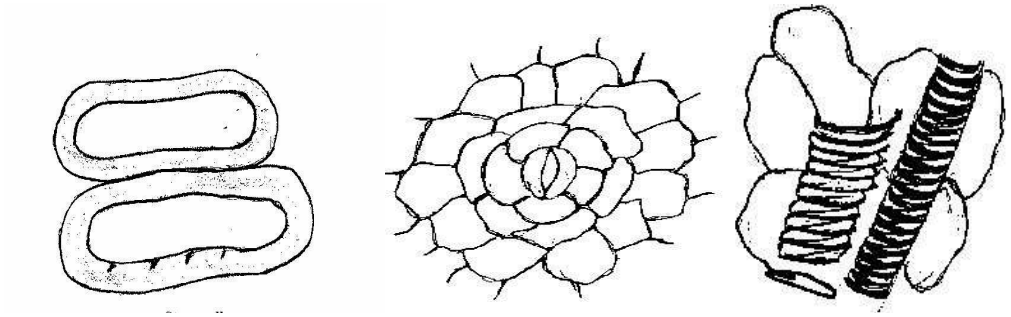
stalk of variable length and spherical head having 3 or 4 cells; mesophyll differentiated into palisade and spongy parenchyma; bicollateral vascular bundles; actinocytic stomata present on both surfaces; stomatal number is 59 - 64 on lower surface and 29 - 39 on upper surface; stomatal index is 13-14 on lower surface and 9-10 on upper surface; palisade ratio not over 3; vein islets number 14-19 per sq. mm.

d. **Fruit -** Section shows irregular outline due to 8-10 prominent ribs; epicarp consist of single layered papillose epidermis covered with thick, striated cuticle having a few bristles, followed by 4-6 layers of thin-walled, tangentially elongated parenchymatous cells, some cells especially near the ribs, having brownish contents; below this thick walled, polyhedral, continuous band of stone cells present, measuring 24-40 µ in dia.; outer 6-8 layers of this band consists of closely packed thick-walled sclereids, while the inner 2-4 layers, thick-walled and distinctly pitted.

e. **Seed -** Testa consists of a single layer of rectangular, thick-walled, sclerenchymatous cells, followed by a tegmen, composed of 5 or 6 layered, oval to polygonal, parenchymatous cells and a single layered elongated, lignified, sclerotic palisade-like cells; endosperm composed of thin-walled, parenchymatous cells; cotyledons flat, consisting of thin-walled, oval to polygonal, parenchymatous cells.

f. **Powder-** Greyish-brown; shows fragments of cork cells, thick-walled, wavy or sinuous epidermal cells, lignified sclerotic or palisade-like cells of testa, sclerenchymatous cells, pieces of unicellular and glandular hairs, vessel with spiral and reticulate thickening, simple or groups of elongated, lignified stone cells, simple, rounded to oval starch grains having concentric striations and narrow hilum, measuring 4-7 µ in dia.

Figure 4
***Powder analysis*[7]**



a. Stone cell ***b. Actinocytic stomata*** ***c. Xylem vessels***

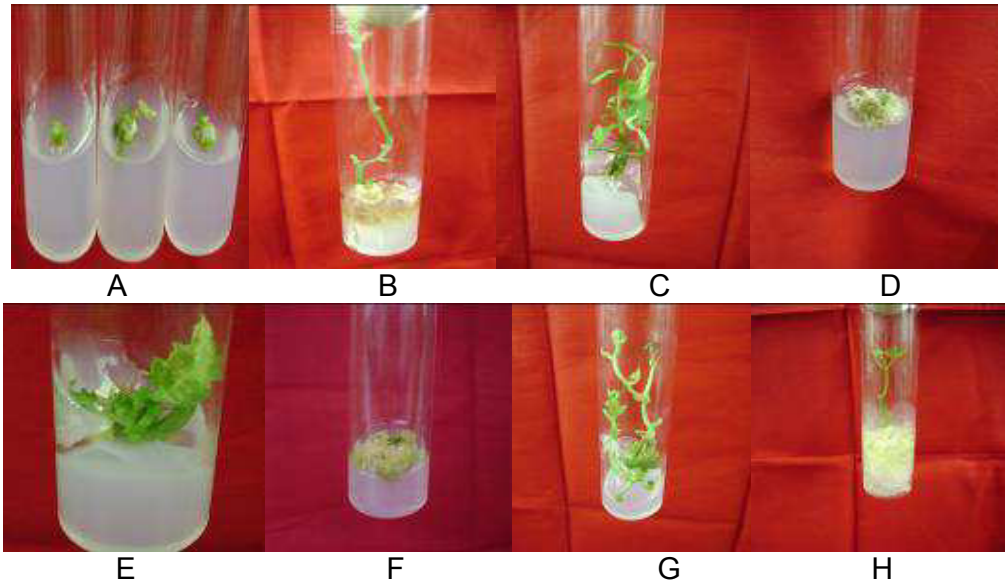
TISSUE CULTURE STUDIES

In-vitro culture study of medicinal plants is important for many reasons. Morphological studies can be done on the endophytic system and various host-parasite relationships (mechanism, physiology, biochemistry, signals and receptors) can beexamined. Secondary metabolite production (i.e., cancer drugs) can be studied, along with the micropropagation and genetic improvement of plants with commercial value. In tissue culture, explants taken from whole plants may produce callus, shoots, roots, seedlings, somatic embryos, haustoria and floral buds. Explants or callus have been used to derive cell suspensions and protoplasts. Regenerated plants can be obtained from somatic embryos or shoots developing from callus.

- **Nahar *et al* (2010)** established the simple rapid *in vitro* regeneration protocol of *L. acutangula* which showed the direct shoot multiplication using 2 mg/l BAP + 0.2 mg/l GA. For callus induction significant result was found using 4 mg/l BAP + 0.2 mg/l NAA. Indirect regeneration was performed by subculturing organogenic callus on MS

medium + 1.5 mg/l BAP + 0.2 mg/l NAA + 0.2 mg/l nicotinic acid. Regenerated shoots were rooted well on MS medium containing NAA at low concentration[8].

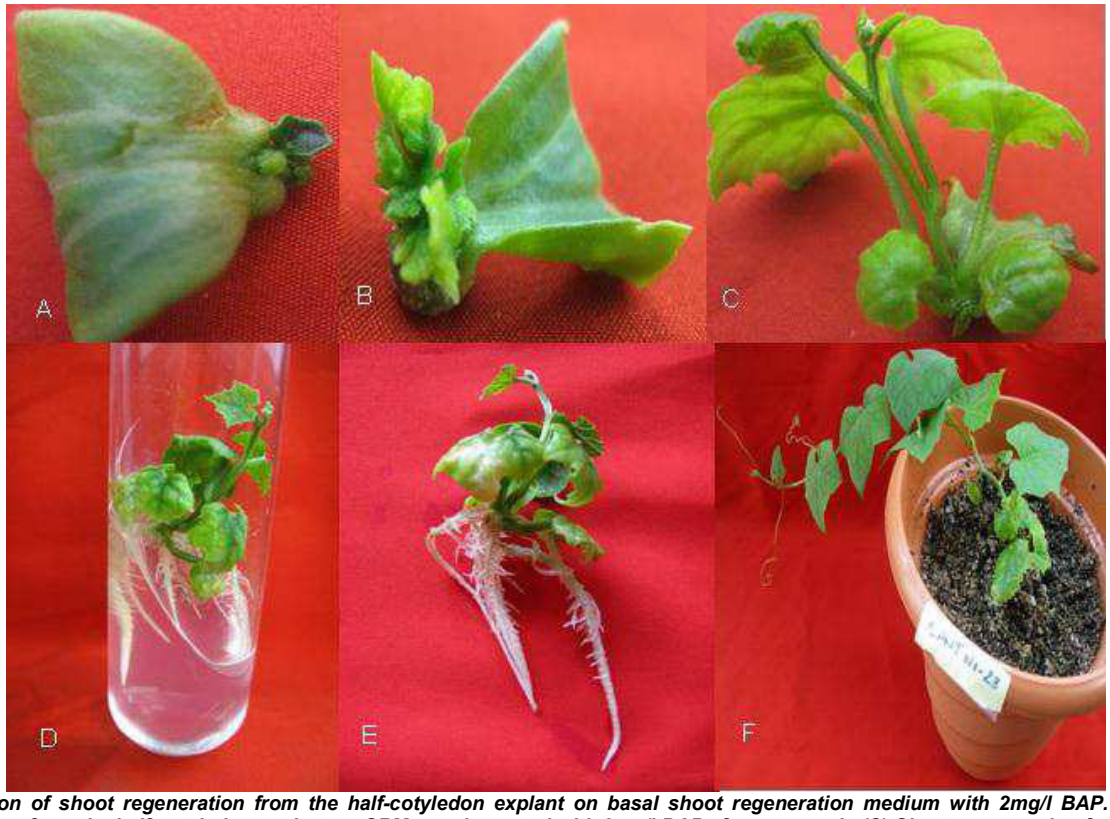
Figure 5 *In vitro* regeneration of *Luffa*



A. Direct shoots multiplication using 1.5 mg/l BAP.
B. Light green callus formation using 3.0 mg/l BAP + 0.2 mg/l NAA.
C. Indirect shoots regeneration using 1.5 mg/l BAP + 0.2 mg/l GA.
D. Root induction using 0.6 mg/l NAA.
E. Direct shoot multiplication using 2.0 mg/l BAP + 0.2 mg/l GA.
F. Light green callus formation using 4.0 mg/l BAP + 0.2 mg/l NAA.
G. Indirect shoot regeneration using 1.5 mg/l BAP + 0.2 mg/l NAA + 0.2 mg/l Nicotinic acid.
H. Root induction using 0.7 mg/l NAA

- **Dandge VS (2012)** studied the *in vitro* antifungal and antibacterial activities of fruits and leaves of *Luffa acutngula* using Asthana and Hawker's medium "A" (5 g glucose, 3.5 g KNO_3. 1.75 KH_2 PO_4, 0.75 g Mg SO_4.7 H_2O and 15 g agar agar). The study showed that fruit extract of *Luffa acutangula* (L) Roxb. possess more potent antibacterial and antifungal activity than leaf extract. *E.coli* showed high sensitivity than *Staphylococcus aureus, Pseudomonas aeroginosa* species to leaf and fruit extract of *Luffa.* Among fungi *Curvularia lunata* was found highly sensitive to leaf and fruit extract of Luffa while to same extract *Phomasorghina* showed poor sensitivity[9].
- **Netrapal Singh (2011)** studied the effect of oxytocin on *in vitro* regeneration using cotyledon explant. A regeneration medium consisting of MS salts, B5 vitamins supplemented with different concentrations of oxytocin with 2mg/l BAP was used for culturing of cotyledon explants. The increase in shoot length was observed and these regenerated shootlets were rooted on half MS basal medium with 2.5 µM IBA. The developed plantlets were acclimatized successfully[10].

Figure 6 (A-F)
Effect of oxytocin on in vitro regeneration ofLuffa acutangula



(A) Initiation of shoot regeneration from the half-cotyledon explant on basal shoot regeneration medium with 2mg/l BAP. (B) Shoot regeneration from the half-cotyledon explant on SRM supplemented with 2mg/l BAP after one week. (C) Shoot regeneration from the half-cotyledon explant on SRM supplemented with 2mg/l BAP and 8µl/ml oxytocin after one week. (D& E) Adventitious root induction from the elongated shoot in half strength MS medium supplemented with 2.5µM IBA. (F) Fully developed plant growing in pot.

PHYTOCHEMISTRY

Work has been done by many scientists in the field of phytochemical investigation of the plant. The reported chemical examination of *Luffa acutangula* showed the presence of carbohydrates, carotene[3], fat, protein, phytin, aminoacids, alanine, arginine, cystine, glutamicacid, glycine, hydroxyproline, leucine, serine, tryptophan, pipecolic acid[11], flavonoids and saponins[12]. An amorphous bitter principle, luffeine is present in fruits and edible portion of fruit contain 94.2% water, 1.7% fiber and leaves contain different types of vitamins and minerals[8]whereas glycerides of palmitic, stearic, and myristic acids are found in seeds, as well as bitter principle Cucurbitacin B, an acid sapogenin, oleanolic acid were also isolated from the seeds of *Luffaacutangula.* The plant also showed presence of oleanane type triterpene saponins-acutoside A, B, C, D, E, F and G[13]. Extensive chromatographic screening of extracts of the fruitsof the Indian Ayurvedic plant, *Luffa acutangula*, resulted in the isolation of chito oligosaccharide specific lectin. The studies after purification by affinity chromatography revealed that lectin has a molecular weight of 48,000 and stokes radius of 2.9 nm. Gel electophoresis using sodium dodecyl sulfate-polyacrylamide showed only single band corresponding to molecular weight of 24,000, in the presence as well as absence of 2-mercaptoethanol which justifies that the subunits in this dimeric lectin are held by non-covalent interactions alone. Further, circular dichroism spectral studies indicate that lectin has 31% α-helix and no ß-sheet and is not a glycoprotein. The binding affinity of lectin specifically to chito oligosaccharides increases with increasing oligosaccharide chain length as observed by near ultra-violet circular dichroism and intrinsic fluorescence titration[14].

Luffangulin, a novel ribosome inactivating peptide with an N-terminal sequence, was isolated from seeds of *Luffa acutangula*. The 5.6 kDa-peptide designated luffangulin inhibited cell-free translation with an

IC_{50} of 3.5 nM but lacked inhibitory activity toward HIV-1 reverse transcriptase[15]. Salt-soluble seed proteins were extracted from *Luffa acutangula* and separated by sodium dodecyl sulphate-polyacrylamide gel electrophoresis (SDS-PAGE) using1-D vertical slab gel containing 5% stacking gel and 11% separating gel. The relative mobility, Rp values, were calculated with respect to bromophenol blue and compared with proteins of known molecular weight, e.g. cytochrome c, lysozyme, enolase and bovine serum albumin (BSA) which were subjected to electrophoresis under identical conditions. *Luffa acutangula* showed the presence of some high molecular weight proteins, havingRp values less than 0.23[16].

NUTRITIONAL IMPORTANCE

The nutritive compositions per hundred gram, edible portion of fruit vegetable is 54%, of which protein is 1.2 gm, carbohydrate -0.2 gm, dietary fiber -3.3 gm, organic acid -0.11gm and 0.6 gm minerals like Ca (14 mg), K (160 mg), Mg (14 mg), Zn (0.2 mg), thiamine(0.05 mg), riboflavin (0.01 mg), niacin(0.20 mg)[9]. The seeds of *Luffa acutangula* were studied for potential nutritional and oil characteristics. The fatty acid profile indicates that the glycerides of oleic and linoleic acid constitute 68% of the total kernel oil. The seeds were also found to be a good source of certain amino acids, phosphorous, iron and magnesium[17].

THERAPEUTIC USES AS DEPICTED BY ETHNOBOTANICAL STUDIES

The ethanobotanical survey of the hilly areas in Maharashtra revealed that fruits of *Luffa acutangula* are used to protect from jaundice when taken as very fine powder through nose in the form of snuff[18]. The entire plant is medicinally important and is used extensively in traditional medicine. Ayurvedic literature revealed that fruits are used in treatment of vata, kapha[6], anaemia, leucoderma, tumors and also useful as diuretic and in splenicenlargement[18].In addition to its medicinal value, the fruit of *Luffa acutangula* are consumed as food in almost every part of India. It is also used traditionally in insect bites by tribes of Western Maharashtra. A powder of the fruit is used for rubbing on the swollen hemorrhoids. Kernel of the seeds is soft smooth and efficient remedy for dysentery while the juice of roasted young fruit is applied to cure headache[9].

BIOLOGICAL ACTIVITIES

A. *Antioxidant activity/free radical scavenging activity*

A comparative study of extracts, prepared both by cold maceration and also by boiling the plant in the solvent under reflux, of vegetables traditionally consumed like angular loofah (*Luffa acutangula*), charungli (*Caralluma edulis*), okra (*Abelmoschus esculentus*) and bitter melon (*Momordica charantia*) was made for free radical scavenging activity (antioxidant property).The IC_{50} value of *L. acutangula* was determined and was found to be 0.33µg/mg[19]. A significant difference in the antioxidant activity was observed between the extract obtained by both methods, in case of *L. acutangula*, indicating the change in chemical composition of the plant during the heating process and increase in the amount of antioxidant components[20].

B. *Hepatoprotective activity*

The hepatoprotective effect of hydroalcoholic extract of fruits (HAELA) using carbon tetrachloride and rifampicin induced liver damage in wistar albino rats was studied. Silymarin was used as standard drug. The study revealed that extract significantly reduced serum marker enzymes(AST,ALT,ALP and LDH). These biochemicalobservations were supplemented by histopathological examination of liver sections which showed increased total protein levels including the improvement in histoarchitecture of liver cells of the treated groups as compared to the control group. The liver histology of the hydroalcoholic extract treated group showed mild to moderate degree centilobular fatty and lymphocyte infiltration and few infiltrations of inflammatory cells[21]. HAELA also showed significant decrease in malondialdehyde (MDA) formation, increased activity of non-enzymatic intracellular antioxidant, glutathoine andenzymatic antioxidants, catalase and superoxide dismutase. The present findings suggest that the fruits of *L. acutangula* possess potential hepatoprotective activity and

endogenous antioxidants and inhibition of lipid peroxidation of membrane contribute to hepatoprotective activity of hydroalcoholic extract of *L. acutangula*. Saponin fraction of *Luffa acutangula* seeds was also investigated for hepatoprotective activity in CCl_4 induced liverfibrosis. The study was done on male Wistar rats, divided into six groups-normal group, control group, standard group and three test groups (given saponin fraction of *Luffa acutangula*). The study revealed the dose dependent hepatoprotection 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.

C. *Antidiabetic Activity*

The blood glucose lowering activity of leaves of *Grewia asiatica,* fruits of *Luffa acutangula* and bark of *Bombax ceiba* was studied using ether, chloroform, ethanolic and aqueous extracts at the dose of 200 mg/kgb.w. on alloxan induced diabetic Wistar rats. Among all extracts, chloroform and alcoholic extracts of fruits of *Luffa acutangula* has reported more significant (p<0.01) reduction in blood glucose level as compared to control. Glibenclamide at 10mg/kg b.w. was used as standard drug[22]. The hypoglycemic activities of methanolic extracts of *Bixa orellana*, *Kyllinga monocephala* and *Luffa acutangula* were evaluated using the Oral Glucose Tolerance Test (OGTT) as modified by Magno (2005). Fasting blood glucose level of the test mice was measured and hyperglycemia was induced by administering 40% (w/v) glucose solution orally. Further modification of this method was employed by measuring the blood glucose level at 15-min intervals until there is an observed significant decrease in the blood glucose level of the mice that belong to the glucose control group. The hypoglycemic activity of the extracts was expressed as percentage decrease in the blood glucose level of the test mice during the hyperglycemic state and the succeeding 15-min interval. Methanolic extracts of *B. orellana* and *L. acutangula* showed significant hypoglycemic activities when administered 15 min after glucose load using a modified oral glucose tolerance test with Swiss Webster mice as test animals. An infusion of *B. orellana* was found to lower blood glucose level when administered 45 min before glucose load, while that of *K. monocephala* was found to lower blood glucose level when administered 15 min after glucose load[23].

D. *Antiproliferative and antiangiogenic effects*

The fruits of *Luffa acutangula* were examined for antiproliferative and antiangiogenic activities using human lung adenocarcinoma epithelial cell line (A-549) and by evaluating vascular endothelial growth factor (VEGF), matrix metalloproteinases-2 (MMP-2) and matrix metalloproteinases-9 (MMP-9) as in-*vitro* and chick chorioallantoic membrane (CAM) as an *in-vivo* model for VEGF . Methanolic extract showed significant antiproliferative activity (IC-50, 131.63±2.31 µg/ml) on human lung adenocarcinoma epithelial cell line (A-549). VEGF and both MMP protein expressions were significantly inhibited in treated A-549 cells compared to control cells (VEGF: 4.36±0.47 and 14±0.75 ng/ml, MMP-2: 10.17±1.3 and 20.28±1.68, MMP-9: 12.93±1.70 and 21.12±2.12 ng/ml, respectively). Egg chorioallantoic membrane showed clear avascular zones compared to phosphate buffered saline (PBS) treated eggs. In conclusion, data provides a scientific proof for *Luffa acutangula* as a potent antitumor agent[24]. The *in vitro* anticancer effect of *L. acutangula* and *L. nodiflora* leafextracts in human lung cancer cell line (NCI-H460) was compared with that of paclitaxel as positive control and the effect was assessed by MTT assay, mitochondrial membrane potential (MMP) alteration, intracellular reactive oxygen species (ROS) measurement and nuclear morphology with the appearance of apoptosis. The leaf extracts exhibits high antiproliferative activity against cell line tested, as determined with MTT assay. The concentrations of growth inhibition at 50% (IC_{50}) ranged from 1 to 50 µg/mL after 24 h treatment and the IC_{50} was found to be 20 µg/mL and 10 µg/mL for *L. acutangula* and *L. nodiflora*, respectively. Both extract treated groups exhibits high DCF fluorescence (enhanced ROS levels), significant increase in mitochondrial

depolarization when compared to control groups. Nuclear morphology with induction of apoptosis in cells treated with leaf extracts were also observed by microscopic examination using dual staining method of acridine orange-ethidium bromide[25].

E. *Anticataleptic activity*

The anticataleptic effects of ethanolic extract of *Luffa acutangula* were studied in haloperidol induced of catalepsy in Albino Wistar rats. Ethanolic extract of *Luffa acutangula* at dose of 400 mg/kg exhibited a pharmacological effect similar to that of standard drug (L-DOPA) and further potentiation was observed with L-DOPA+ Carbidopa+EELA combination therapy. Haloperidol a neuroleptic, upon long term administration causes oxidative stress, resulting from alterations of mitochondrial electron transport chain, has been responsible for its neurotoxicity[26, 27]. EELA at a dose of 400 mg/kg significantly reversed the haloperidol inhibited locomotor activity. The standard drugs L-DOPA, L-DOPA+ carbidopa and EELA+L-DOPA+carbidopa combination also significantly reversed the haloperidol inhibited motor activity. EELA at a dose of 400 mg/kg significantly, increase the exploratory behaviour like head dipping and line crossing in haloperidol administered rats. The standard drugs L-DOPA, L-DOPA+carbidopa and EELA+ L-DOPA+carbidopa combination also significantly increased the exploratory behaviour in haloperidol administered rats[28]. From the observations, it was concluded thatthe protective effect of EELA against symptoms of Parkinson's disease (catalepsy) may be due to regulation in neurotransmitters such as dopamine, serotonin, glutamate which are playing an important role in protection of catalepsy and antioxidant properties[29].

F. *Analgesic activity*

The analgesic activity of *Luffa acutangula* was studied on adult albino rats using tail flick method and tail immersion method. The ethanolic extract showed significant activity with the reaction time of 6.25±0.52 in tail flick method and 5.80±0.50 in tail immersion method at the dose of 400 mg ml^{-1} as compared to pentazocin (standard). The analgesic activity may be due to its free radical scavenging activity and central modulation of pain by dopaminergic, noadrenergic and seratonergic systems[30].

G. *Antiulcer activity*

Protective effect of *Luffa acutangula* extracts (methanolic and aqueous) on gastric ulceration in NIDDM rats was studied by inducing diabetes with Streptozotocin (65mg/kg, i.p.) along with nicotinamide (120 mg/kg, i.p.) and gastric ulceration to diabetic rats was induced by aspirin. LAM significantly ($P<0.01$) increased mucosal glycoprotein and antioxidant enzyme level in gastric mucosa of diabetic rats than LAW ($P <0.05$). LAM was efficient in reversing the delayed healing of gastric ulcer in diabetic rats close to the normal level. LAM exhibited better ulcer healing effect than glibenclamide and LAW, because of its both antihyperglycemic and mucosal defensive actions. Thus, LAM is proved to be a better alternative for treating gastric ulcers co-occurring with diabetes[31].

H. *Antimicrobial activity*

Fruit extract of *Luffa acutangula* (L) Roxb. was found more potent antibacterial and antifungal activity than leaf extract. Among the bacteria, *E. coli* showed high sensitivity than *Staphylococcus aureus* and *Pseudomonas aeroginosa* species to leaf and fruit extract of *Luffa*. The antifungal property was evaluated on various species and *Curvularia lunata* was found highly sensitive to leaf and fruit extract of *Luffa* while to same extract *Phomasorghina* showed poor sensitivity. Thus, it was concluded that plant possess significant antibacterial and antifungal poperties[9].

I. *Developmental toxicity*

The tea made from *Luffa acutangula* fruits has been largely used by women for abortion induction and abortions occurred in ruminants that had ingested the fruits. Eleven pregnant Wistar female rats were used. On the 15th gestational day, six rats were dosed with 10 mL kg^{-1} of *L. acutangula* tea (50 g of dried fruit in 100 mL of water) and the other five rats were dosed with saline solution. On the 21st gestational day, all the rats were submitted to cesarean section. There was no difference between the two groups on body weight and

body weight gain and no sign of maternal toxicity was observed in females throughout the experiment. The number of points of implantation, live and dead foetuses, corpora lutea and points of reabsorption did not differ between groups but it was found reduced foetal weight in the group treated with *L. acutangula*. The search for external malformations revealed a foetus with cleft palate from a plant-treated mother. No lesion was found at histological evaluation of placentas. In conclusion, the ingestion of *L. acutangula* during pregnancy may promote developmental toxicity[32].

J. *Other properties*

The seeds of *Luffa acutangula* contain a saponin which cause haemolysis and also possess digitalis like action. In the indigenous system of medicine the pounded leaves are applied locally in splenitis, haemorrhoids and leprosy. It also contains cucurbitacin compounds which have got significant anti-neoplastic properties.Studies on *Luffa acutangula* show that it possess larvicidal activity.The oil obtained from the seeds of *L. acutangula* can be used both as edible oil and also for soap making. The plant is also used as an emetic. The juice of heated ridge gourd is good for diabetes. The tonic is used for intestinal problem. It can cure vatta, kapha[6], anaemia, asthma, jaundice, leucoderma, tumors. It is also useful as diuretic and in splenic enlargement. The dried fruit powder is used in the form of snuff in jaundice[18]. The seeds possess emetic, expectorant and demulcent property. It is also used traditionally in insect bites by tribes of Western Maharashtra. A powder of the fruit is used for rubbing on the swollen haemorrhoids. Kernel of the seeds is soft smooth and efficient remedy for dysentery[33]. Juice of roasted young fruit is applied to cure headache. Pulp of fruit is also applied to different kinds of bites. It causes vomiting and purging through which the poison is eliminated. Dried fruit is used as a snuff in jaundice or its watery extract is dropped in nostrils. Roots with other plant material are used in gonorrhoea and leaf juice is used as a powerfuldiuretic[9].

CONCLUSION

The survey of literature revealed that *Luffa acutangula* is the source of many therapeutically important chemical constituents as luffangulin, cucurbitacin, oleanolic acid, myristic acid, amino acids, oligosaccharides etc. Studies have revealed its use in diabetes, immunomodulation, tumor suppression, parkinsonism, antimicrobial, ulcer and hepatoprotection. The fruit is consumed as food product all over the India However, not much information is there to prove the use of this plant for paralysis, asthma, pulmonary tuberoculosis and menstrual troubles. Therefore, further studies may be carried out to prove the potential of this plant. Besides this, some preliminary work has been done on the use of this plant as an antitumor agent, but the detail studies to explore the mechanism are in progress by our research team.

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