Literature Review: Potential Pharmacological Activity of Luffa cutangula L. Roxb

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Abstract
Indonesia is a fertile country with various kinds of herbal plants that can grow in it. This situation has led to the widespread use of herbs in society and has even become part of Indonesian culture. There are various empirical results from the use of herbal plants in Indonesia. Luffa acutangula (gambas) is one of the many plants found in Indonesia. This plant has been widely used in helping to treat various diseases. A journal search was conducted on the pharmacological activity of Luffa acutangula in the early stages of pre-clinical trials (in vitro and in vivo) and then presented in a literature review to prove the empirical benefits of this herb. The results of potential pharmacological activities of Luffa acutangula include antimicrobial, antiparasitic, anticancer, antioxidant, antiinflammatory, antithyroid, hypoglycemic treatment, analgesic, immunomodulatory, hepatoprotective, and gastroprotective. The results of a literature review study on the pharmacological activity of Luffa acutangula show evidence of pre-clinical empirical benefits. It is hoped that by obtaining more comprehensive data like this literature study, it is hoped that it will serve to collect information on the use of Luffa acutangula as a medicinal preparation.

1. Introduction
Indonesia has a very diverse wealth, namely wealth in the form of plants, animals and minerals. With fertile soil, various plants can grow in Indonesia. These various plants, including herbal plants, can be used as medicinal plants, which help people to maintain health and help in healing various health problems. Luffa acutangula or in Indonesia known as gambas is a plant originating from India, especially the western, central and southern regions of India. This plant can grow in tropical and subtropical climates, and is found in many parts of Indonesia (Raja et al., 2017).

Gambas belongs to the Cucurbitaceae family. Some of the plants included in the Cucurbitaceae family include various types of pumpkins, melons, and pumpkins, as well as plants such as cucumbers, pumpkins, luffas, and watermelons (Tupe et al., 2013). In Indonesia, people have often used luffa in their daily life. The parts that are widely used from luffa are fruit, seeds, leaves, and roots, but almost all parts of the plant can be used. From generation to generation luffa has been used by Indonesians as food, vegetables and to treat skin and is used to treat various diseases, for example to treat skin disorders. Most of the luffa is consumed as vegetables, while in its dry form it is often used as a cleaning sponge (Anitha & Miruthula, 2014). In the Madura area, East Java, luffa seeds which have a very bitter taste are empirically used by some residents as a medicine when they are exposed to malaria. Luffa seeds (L. acutangula L. Roxb) are also traditionally used to help treat diabetes in the community. Obtained from the results of research that the seeds or luffa fruit have an effect on reducing blood sugar levels than people with diabetes. The study also showed the results of the acute...
toxicity test that the luffa fruit extract was not toxic up to a dose of 3000 mg/kg BB rats (Jyothi et al., 2010).

Ethnopharmacological studies of a plant are needed to further investigate the various benefits that have been felt empirically from society. The luffa plant is one of the plants that has therapeutic properties empirically. Therefore, the pharmacological activity of the simplicia and *L. acutangula* extract needs to be traced from various published journal articles to be presented as the results of pre-clinical research that are more verifiable than empirical results.

2. **Method**

The search for scientific literature published both nationally and internationally is carried out using electronic databases in the form of PubMed and Google Scholar. In searching for literature, the keyword *luffa acutangula* was used, an article since 2010. A journal search was conducted on the pharmacological activity of *Luffa acutangula* in the early stages of pre-clinical trials (in vitro and in vivo) and then presented in a literature review to prove the empirical benefits of this herb.

3. **Result**

**Pharmacological Activities of *Luffa acutangula***

The use of *L. acutangula* has been widely used by people from various generations. Some parts of the luffa that are widely used by the community are fruit, seeds, leaves and roots. Luffa fruit is used in the treatment of spleen disorders, helps detoxify the liver, relieves constipation, relieves edema as a result of its diuretic effect, anti-diabetes and stomach worm-killing drugs. Luffa seeds are used in the form of oil for skin care. The fresh leaves are used as a dressing material for diseases such as enlarged spleens and skin disorders such as ringworm and leprosy. The leaf powder can be mixed with garlic as a leprosy rub. The leaves can also be used for the treatment of dysentery. Luffa root can be useful for removing kidney stones (Shrivastava & Roy, 2013; Raja et al., 2017; Chanda et al., 2019). Table 1 below show some published research results regarding the published benefits of *L. acutangula*.

| No | Pharmacological Activities | Research | Results |
|----|-----------------------------|----------|---------|
| 1. | Antimicrobial | (Menghani, Ojha, Negi, Agarwal, & Pareek, 2011) | The antibacterial effect of ethanolic extract of *Luffa acutangula* was studied against *Pseudomonas aeruginosa, Escherichia coli, Staphylococcus aureus, and Candida albicans*. Nanoparticel of *L. acutangula* extract has antibacterial and antifungal activity against *E. coli* and *Saccharomyces cervisiae*. |
| 1. | Antiparasitic | (Taruna, Kaushal, Bhatti, & Kumar, 2016) | The methanolic extract of *L. acutangula* showed moderate anthelmintic activity. At a concentration of 10 mg/ml, it causes paralysis and death of stomach worms after > 90 minutes. |
| 1. | Anticancer | (Dashora & Chauhan, 2015) | The anticancer activity of ethanol and water extracts (200 and 400 mg/kg BW, of *L. acutangula* was evaluated in mice for a significant reduction, tumor volume, and tumor weight of Ehrlich ascites carcinoma (EAC) cells. |
| 1. | Antioxidant | (Suryanti, Dewi Marliyana, & Wulandari, 2015) | The methanol extract of *L. acutangula* fruit showed antioxidant activity, which results were higher than that of the hexane and water extracts. The chemical compound content of *L. acutangula* fruit extract has an antioxidant effect |
| 1. | Hypoglycemic | (Raj et al., 2013) | The antidiabetic activity of the ethanol extract of the fruit and seeds of *L. acutangula* significantly reduced blood sugar levels in streptozotocin-induced diabetic rats. |
| 1. | Hepatoprotektif | (Abid et al., 2014) | The hepatoprotective activity of the fruit alcohol extract of *L. acutangula var amara* showed good |
7. Gastroprotective (Pimple et al., 2013) Gastroprotective effect of *L. acutangula* methanol extract and water on stomach ulceration of streptozotocin-induced diabetic rats.

8. CNS (Gandhare, 2012) The protective effect of the ethanol extract of *L. acutangula* against Parkinson's disease symptoms and catalepsy by regulation of neurotransmitters and antioxidant properties.

9. Antiinflammatory (Gill, et al., 2011) The ethanol seed extract of *L. acutangula* fruit extract has an anti-inflammatory effect.

10. Analgetik (Gill, et al., 2011) The ethanol seed extract of *L. acutangula* as an analgesic in rats using the flick and tail immersion method.

11. Immunomodulator (Jayasingrao & Sunil, 2019) Fruit wall ethanol extract of *L. acutangula* can increase phagocytosis and neutrophils.

12. Antithyroid (Sunhre, Kar, & Panda, 2020) The ethanol extract of *L. acutangula* rind can be useful in the regulation of thyrotoxicosis disorders.

4. Discussion

The pharmacological activity of *Luffa acutangula* has an antibacterial effect. Based on the research of Menghani et al. (2011), *Luffa acutangula* has the potential for antimicrobial activity against gram-negative bacteria *Staphylococcus aureus*. Its use can be added to daily food to treat acne. The ethanol extract of *Luffa acutangula* was tested for antibacterial, showing a good inhibition zone. The methanolic extract has the potential to make an inhibition zone (IZ). Inhibition zone (IZ) against *Pseudomonas aeruginosa* showed IZ= 10mm, GPB showed IZ=8mm, *Staphylococcus aureus* positive strain showed IZ=8mm, *E.coli* showed IZ= 9mm, *Staphylococcus aureus* negative strain showed IZ = 8mm, and in antifungal activity in the inhibition zone against *Candida albicans* is showed 8mm. The aqueous extract of *Luffa acutangula* was prepared by green synthesis is made into silver nanoparticles (AgNPs) preparations and characterized using UV-Visible spectroscopy, Fourier Transform infrared spectroscopy (FTIR), Energy dispersive spectroscopy (EDS), and Transmission electron microscope (TEM). Antimicrobial activity against *Escherichia coli* and *Saccharomyces cerevisiae* are checked by the disc diffusion method. The silver nanoparticles showed an inhibition zone against the bacteria - *E. coli* and fungus-*Saccharomyces cerevisiae*. The inhibition zone is 10 mm and 11 mm round silver nanoparticles against *E. coli* and *Saccharomyces cerevisiae*, respectively (Taruna et al., 2016).

The methanol extract of *Luffa acutangular* showed moderate anthelmintic activity. At a 10 mg/ml concentration, it causes paralysis and death of stomach worms after > 90 minutes. *In-vitro Evaluation of Cytotoxic and Anthelmintic Activity of Luffa acutangular* (Rahman et al., 2014). The bioactive compound of 1, 8-dihydroxy-4-methylanthracene-9, 10-dione (DHMA) isolated from the *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. The DHMA inhibited the cell viability of NCI-H460 cells in a dose-dependent manner with an IC (50) of about 50 µg/ml. It significantly reduced cell viability correlated with the 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 proteins such as p53, p21, Bax, and caspase-3 but downregulated the expression of NF-κB in the NCI-H460 cell line. 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 *Luffa acutangula* against NCI-H460 cell line. Therefore, DHMA has therapeutic potential for lung cancer treatment (Vanajothi et al., 2015).

The anticancer activity of the ethanolic and aqueous extracts of the *Luffa acutangula* in Swiss albino mice against Ehrlich Ascites Carcinoma (EAC) cell line. Anticancer activity of ethanolic and aqueous extracts of *Luffa acutangula* was evaluated in EAC Swiss albino mice at the doses of 200 and 400 mg/kg body weight orally. Both extracts at both doses were administered for 13 consecutive days. After 24 h of the last dose and then eighteen hours of fasting, the mice were sacrificed, and the antitumor effect of ethanolic and aqueous extracts was assessed by evaluating tumor volume, viable and nonviable tumor cell count, tumor weight, and hematological parameters of EAC bearing host. Ethanolic and aqueous extracts showed a significant decrease in (p<0.0001) tumor volume, viable cell count, tumor weight, and elevated the life span of EAC tumor-bearing mice. Hematological profiles such as red blood cell (RBC), hemoglobin, and white blood cell (WBC) count reverted to normal level in treated mice. The results demonstrated that the extract has potent dose-dependent anticancer activity comparable to that of cisplatin. Aqueous extract at both doses (200 and 400 mg/kg) and ethanolic extract at 400 mg/kg dose showed potent anticancer activity (Dashora et al., 2015).

Antihyperglycemic activity of the methanolic fruit extract of *Luffa acutangula* was evaluated through oral glucose tolerance tests in glucose-loaded mice. The methanolic extract of the fruits significantly and dose-dependently reduced blood glucose concentrations (38.5, 39.6, and 41.8% reduction at 100, 200, and 400 mg/kg BW). At a lower extract dose of 50 mg per kg BW, the extract reduced blood glucose concentrations by 13.1%, but the effect was not statistically significant (Jurna et al., 2013). The antidiabetic activity of fruits and seeds ethanolic extract of *Luffa acutangula* was studied in streptozotocin-induced diabetic in rats. The extract (200 and 400 mg/kg) significantly (p<0.05) reduced fasting blood glucose of streptozotocin diabetics rats in a dose-related manner, with maximum hypoglycemic effect after 21 days (Raj et al., 2012). The hypoglycemic activity of the methanolic leaves extract of *Luffa acutangula* was evaluated in mice. *Luffa acutangula* extract possessed significant hypoglycemic activity when administered 15 min after glucose load using a modified oral glucose tolerance test in mice. Among three plant extracts (*Bixa orellana, Kyllinga monocephala* and *Luffa acutangula*), *Luffa acutangula* showed the most potent glucose level decreasing effect (37.5%) comparable to that possessed by glibenclamide (37.88%) (Quanico et al., 2008). The hypoglycemic effect of petroleum ether, chloroform, and ethanol extracts of fruits of *Luffa acutangula* was evaluated in alloxan-induced diabetic Wister rats. Chloroform and alcoholic extracts of fruits of *Luffa acutangula* showed more significant (p< 0.01) reduction in blood glucose level in alloxan-induced diabetic Wister rats compared to control and glibenclamide (10 mg/kg BW) (Patil et al., 2010). The antidiabetic and antihyperlipidemic potentials of methanolic and aqueous extracts (100, 200, and 400 mg/kg, PO) of *Luffa acutangula* (LA) fruits were studied in Streptozotocin (65 mg/kg, IP) and nicotinamide (120 mg/kg, IP) induce non-insulin-dependent diabetes mellitus in rats. The methanolic extract at a dose of 100 mg/kg was found to be active (p< 0.05), but the antidiabetic activity was increased significantly (p< 0.01) at a dose of 200 and 400 mg/kg as compared to the aqueous extract, the methanolic extract also showed dose-dependent pronounced (Pimple et al., 2011).

Hepatoprotective activity of hydroalcoholic extract of *Luffa acutangula* (HAELA) against carbon tetrachloride (CCl4) and rifampicin-induced hepatotoxicity in rats was evaluated, and probable mechanism(s) of action has been suggested. Administration of standard drug- silymarin and HAELA showed significant hepatoprotection against CCl4 and rifampicin induced hepatotoxicity in rats. Hepatoprotective activity of HAELA was due to the decreased levels of serum marker enzymes viz., (AST, ALT, ALP, and LDH) and increased total protein, including the improvement in histiarchitectue of liver cells of the treated groups as compared to the control group. HAELA also showed a significant decrease in malondialdehyde (MDA) formation, increased activity of non-enzymatic intracellular antioxidant, glutathione, and enzymatic antioxidants, catalase, and superoxide dismutase. Results of this study demonstrated that endogenous antioxidants and inhibition of lipid peroxidation of membrane contribute to the hepatoprotective activity of HAELA. (Jadhav et al., 2010).
The hepatoprotective activity of *Luffa acutangula var amara* fruits extracts was studied against carbon tetrachloride-induced hepatotoxicity. Alcoholic extract (150 mg/kg, PO) showed good hepatoprotective activity, while petroleum extract (150 mg/kg, PO) showed moderate hepatoprotective activity as compared with standard silymarin (100 mg/kg, per oral administration) (Abid *et al.*, 2014).

Gastroprotective activity effect of *Luffa acutangula* methanol extract and water on stomach ulceration of streptozotocin-induced diabetic rats. The *Luffa acutangula* methanolic extract (LAM) and aqueous extract (LAW) on type 2 diabetes rats induced streptozotocin dose 65mg/kg, i.p along with nicotinamide dose 120 mg/kg, i.p. use rats animal models non-insulin-dependent diabetes mellitus (NIDDM). A daily oral dose of aspirin (200 mg/kg, i.p.) was administered for initial seven days to induce gastric ulceration in the diabetic rats. LAM and LAW were administered orally in the doses of 100, 200, and 400 mg/kg once daily for 21 days. Glibenclamide and ranitidine were used as standards for comparing the antidiabetic and antiulcer effect, respectively. 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 ulcers in diabetic rats close to the normal level. LAM exhibited a better ulcer healing effect than glibenclamide and LAW because of its both antihyperglycemic and mucosal defensive actions. LAM proved to be a better alternative for treating gastric ulcers co-occurring with diabetes (Pimple *et al*., 2012).

Analgesic and anti-inflammatory activity of ethanolic seed extract of *Luffa acutangula* in the albino rats. Anti-inflammatory activity with *Luffa acutangular* dose extract were 100, 200, and 300 mg/kg, oral. This activity was evaluated by carrageenan-induced paw edema and analgesic activity (200 and 400 mg/kg, oral) by tail-flick and tail immersion methods. Significant anti-inflammatory activity at the dose of 300 mg/kg while analgesic activity at the dose of 400 mg/kg was shown by seed extract (Gill *et al*., 2011). Based on ethnopharmacology of *Luffa acutangula* as a pain-relieving agent but the results are still unconvincing as humans. The analgesic activity of *Luffa acutangular* was studied with the help of ethnicanol extract on adult albino rats using the tail-flick method and tail immersion method. This extract showed significant activity with the reaction time of 6.25±0.52 in the tail-flick method and 5.80±0.50 in the tail immersion method at the dose of 400 mg/ml as compared to pentazocine (standard). The analgesic activity is may be due to its free radicals scavenging activity and central modulation of pain by dopaminergic, noradrenergic, and serotonergic systems (Fernandes *et al*., 2010).

Ethanolic extract of fruit pericarp *Luffa acutangula* dose 100 and 200 mg/kg administration per oral was investigated for immunomodulatory activity in Swiss albino mice. The evaluation of the phagocytic index revealed that administration of the ethanolic extract (200 mg/kg) in Indian ink intoxicated mice led to an increase in phagocytosis to 0.028 ± 0.002 (P < 0.01). Also, the % neutrophil adhesion in mice (200 mg/kg) was increased to 24.63 ± 0.87%, which was more than the standard drug Levamisole (23.58 ± 0.46%) (Kalasakar and Surana, 2014). Further investigations are needed to provide evidence for its immunomodulatory activity.

*Luffa acutangula* peel extract in T4-induced hyperthyroid female mice. Animals were made hyperthyroid by administering a pre-standardized dose of L-thyroxin (L-T4 at 0.5 mg/kg/day) for 12 consecutive days, and then the effects of the test peel extract at 25 and 50 mg/kg for 15 days were studied on the changes in serum thyroid hormones, glucose, different lipids; hepatic lipid peroxidation (LPO); enzymatic antioxidants such as superoxide dismutase, catalase, glutathione peroxidase, and in reduced glutathione. The main chemical constituents of the extract were identified by high-resolution liquid chromatography-mass spectrometry. Administration of the test peel extract to the hyperthyroid mice at both the test doses decreased the levels of serum thyroid hormones, glucose, and tissue LPO suggesting it is antithyroid (Latta *et al*., 2020).

The bioactive compounds of *Luffa acutangula* in isolation and identification of approximately 50 compounds, such as flavonoids, anthraquinones, proteins, fatty acids, saponin triterpene, volatile components, and other phytocnstituent. These metabolites have pharmacological activities (Shendge and Belemkar, 2018).
5. Conclusion

Indonesia is a country with a tropical climate so that many plants can thrive. The *L. acutangula* (luffa) plant is a plant originating from India. It is widely grown and found in Indonesia and has been widely used by the Indonesian people both from its fruit, leaves, seeds, and roots. Based on ethnopharmacological studies, *L. acutangula* is a medicinal plant often used in traditional medicine in various countries. Pharmacological activity in pre-clinical trials showed that *L. acutangula* has the potential to be antimicrobial, anticancer, antioxidant, hypoglycemic, hepatoprotective, gastroprotective, immunomodulatory, antiparasitic, antiinflammatory, analgesic, and antithyroid.

6. Conflict Of Interest

There are no conflicts of interest in this article

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