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A systematic review on exploration of therapeutic potential of *Aparajita* (*Clitoria Ternatea* Linn)

Review Article

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Abstract

Aparajita (*Clitoria ternatea* Linn), is an herb widely distributed in the humid, lowland tropics of Africa, Asia, and Central America. *Aparajita* is known for its *katu*, *tikta*, *kashaya* rasa, and *vishaghna* (which alleviate toxins) properties. It is used in the treatment of various diseases and is a major ingredient in various anti-poisonous formulations. Pharmacologically, it has actions like insecticidal, cholinergic, antioxytocic, antihistaminic, analgesic, diuretic, purgative, laxative, and abortifacient. A systematic review is attempted based on preclinical studies to prepare a strong platform for the clinical utilisation of *Aparajita* as a main drug. The research papers reporting the study of *Clitoria ternatea* Linn in animals (In vivo and in vitro) were searched for systematic review. The literature search was performed using keywords like 'preclinical studies on *Aparajita,'* 'animal studies on *Aparajita,'* and 'pharmacological studies on *Aparajita,'* in combination with various effects in animals, in the following databases: PubMed/Medline, Scopus, Science Direct, Google Scholar, AYUSH Research Portal, and DHARA for studies published up to December 2021. Many preclinical studies reported that *Clitoria ternatea* Linn has diuretic, nootropic, anti-asthmatic, anti-inflammatory, analgesic, antipyretic, antidiabetic, antilipidemic, antioxidant, and wound healing properties. In the contemporary view, several pharmacological studies and preclinical studies prove the effectiveness of *Clitoria ternatea* Linn in various diseases. However, very few clinical studies of *Clitoria ternatea* Linn were done. Further clinical research should be conducted to establish the therapeutic potential of the drug *Aparajita*.

Keywords: *Clitoria ternatea*, Aparajita, Fabaceae, Girikarnika, Vishaghna, Systemic Review.

Introduction

Aparajita (*Clitoria ternatea* Linn) is mentioned in Ayurveda as important herb. It is widely distributed throughout the humid, lowland tropics of Africa, Asia, and Central America. In India, it is also found throughout the country's tropical regions cultivated in gardens, and often found growing over hedges and thickets. It is commonly called "*Girikarnika*" in the Sanskrit language where it is reported to be a good *Medhya* drug (brain tonic). From an Ayurvedic point of view, *Aparajita* has *katu* (Pungent), *Tikta* (Bitter), and *Kashaya* (Astringent) taste. *Vipak* of *Aparajita* is *Katu* and *Virya* (Potency) of the plant is *Sheeta* (Cold) whereas the properties of the plant are *Laghu* (Light) and *Rooksha* (Dry). In *Bhavprakash nighantu* and *Kaiyadev nighantu,* it is mentioned as *Vishapaha* (which alleviates toxins) (1,2). In *Susruta Samhita* it is included in *Arkaadigana* which is *Vishapaha* which eliminates poison and is mentioned in Snakebite poisoning treatment. (3) Acharya Charaka and Vagbhata also described *Aparajita* in the treatment of Snakebite poisoning. (4,5)

Acharya Charaka included *Aparajita* in '*Shirovirechanopag'* and '*Vayasthaapana Mahaakashaaya*.' *Aparajita* is used to prepare *Yavagu* which is used in the treatment of *Sthavara* and *Jangama visha*. *Aparajita* is also a major ingredient in various *Agada* (anti-poisonous formulations) like *Mahasugandhi Agada, Yapanaagada, Rushabakaddi Agada, Amritaghrita, Suryodaya Agada, Lodharadi Agada*. (6) In *Visha Upadrava* (Complication of poisoning) if there is excessive bleeding due to poisoning, *Suvarna bhasma* with juice or paste of *Aparajita* is indicated for treatment. In Nighantus also *Aparajita* was mentioned in various *varga* (Special class of drug). In Bhava Prakash Nighantu and Raaj Nighantu, *Aparajita* was mentioned in *Guducchyadi varga*. In Nighantu Adarsha, Aparajita mentioned in *Palashadi varga*. In all these nighantu, *Aparajita* was mentioned as *"Vishaghna"* (Anti-poisonous drug).(7)

Traditionally it is useful in the treatment of *udara* (Ascitis), *jwara* (Fever), *mutravikara* (Urinary system disease), *galaganda* (Goiter), *gandmala* (Scrofula), *shotha* (Swelling), *netraroga* (Diseases of Eyes),

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unmada (insanity), *aamavata* (Rheumatism), *kushtha* (all skin diseases), and *vishavikara.* (8)

Pharmacologically, this plant has actions like Insecticidal, Cholinergic, Anti-oxytocic, Antihistaminic, Analgesic, Diuretic, Purgative, Laxative and abortifacient. Though it is described as a very useful drug and mentioned in various Ayurvedic classical texts most of the research work was done concerning the Pharmacological aspect of this drug. Preclinical studies are also available in large numbers but very few clinical studies were done with the interventional drugs a combination of various plant drugs with Aparajita.

Hence to generate scientific evidence for the clinical utilization of *Aparajita* as the main drug, a systematic review is attempted based on previous preclinical studies.

Methods

Literature search and Review strategy

The research publications reporting the study of *Clitoria ternatea* Linn in animals (In vivo and in vitro) were searched for systematic review. The literature search was performed using keywords like 'preclinical studies on *Aparajita,* animal studies on *Aparajita,* pharmacological studies on *Aparajita,* in combination with various effects in animals, in the following databases: PubMed/Medline, Scopus, Science Direct, and Google Scholar for studies published up to December 2021. The literature search was conducted with all parts of the plant (seed, flower, root, leaf) used for preclinical research in any animal. The research articles obtained with the above-mentioned databases and keywords were analyzed by interpreting the 'abstracts' or 'full text.'

Inclusion and exclusion Criteria

All types of animal studies and in vitro studies were included in this study.

Studies with all parts of the plant like roots, leaves, flowers, and seeds were included in this study.

Eligibility Criteria

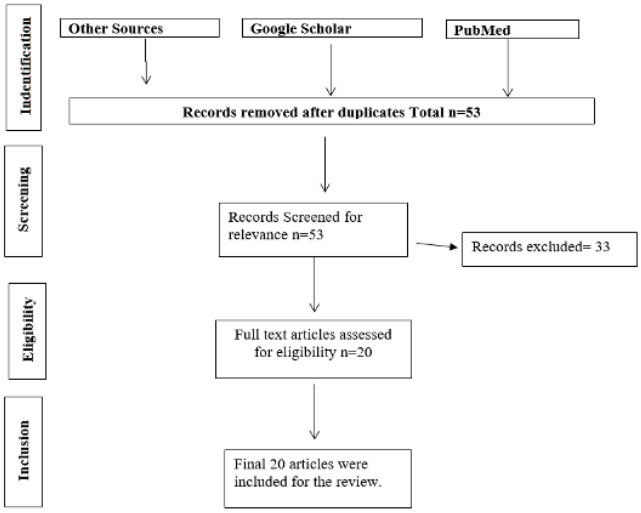
Eligible study type: preclinical study
Eligible study participants: any type of animal.
Eligible study interventions: any part of the *aparajita* plant**.**
Type of outcome measures: Efficacy of part (root, leaf, flower, seeds) of *Aparajita* plant in any disease.

Observations

This search process for systemic review was done as per "Preferred Reporting Items for Systemic Review and Meta-Analysis guidelines." All selected articles were screened finally by reading available matter and analyzed further.

Results

The current review identified 53 research articles related to *Aparajita (Clitoria ternatea* Linn.*)*. Out of these 33 articles were rejected as they did not fulfill the inclusion criteria. Only 20 articles were selected for further study as they fulfilled the inclusion criteria.



Analgesic Effect of *Clitoria Ternatea* Linn

Shammy et al.,2014 (9) evaluated the methanolic leaf extract of *Clitoria ternatea* Linn for analgesic and Neuropharmacological activity. *Clitoria ternatea* Linn plant produces a reduction in pain without any side effects against chemical-induced pain in mice. This study proves the CNS depressant and analgesic potential of *Clitoria ternatea* Linn in a Preclinical study.

Sarwar et al., 2014 (10) evaluate the analgesic and anti-inflammatory activity of *Clitoria ternatea* Linn flower extract. The test drug was administered in doses of 200mg & 400mg/kg. For this study standard drug was used pentazocine (5mg/kg i.p) body weight. Anti-inflammatory action was observed in both dose levels while Analgesic activity was revealed at higher dose levels. The Taraxerol may impact the anti-inflammatory, and analgesic properties of this extract.

Hepatoprotective and Antioxidant Activity of *Clitoria Ternatea* Linn.

Veerabahu et al, 2010 (11) use Ethanol extract of *Clitoria ternatea* Linn and *Cassia angustifolia* Senna leaf for hepatoprotective activity in healthy male Wistar albino rats (total of 25 in numbers) with standard drug Silymarin. Liver toxicity is assessed by measuring the marker enzymes such as Aspartate aminotransferase (AST), Alanine transaminase (ALT), Alkaline phosphatase (ALP), Acid phosphatase (ACP) &Lactate Dehydrogenase (LDH). Leaf extract of *Clitoria ternatea* Linn and *Cassia angustifolia* Senna at the dose of 300mg/kg significantly restored the elevated levels of serum marker enzymes. Based on this result, the present study demonstrates that ethanol extract of *Clitoria ternatea* Linn and *Cassia angustifolia* Senna have potent hepatoprotective activity against Carbon tetrachloride (CCL4) induced hepatotoxicity in rats. However, the exact chemical constituents that are responsible for this action are not mentioned by the researcher.

Nithianantham et al., 2011 (12) evaluated the Hepatoprotective and antioxidant activity of *Clitoria ternatea* Linn against experimentally induced Liver

injury. Assessment of antioxidant properties of *Clitoria ternatea* Linn was done by Radial scavenging (DPPH) assay. The percentage of free Radical scavenging activity was 67.85% for the *Clitoria ternatea* Linn extract. This is more than the value of vitamin E (43.30%). Good antioxidant activity was observed because of Phenolic and Flavonoid compounds. The hepatoprotective activity of Leaf extract was carried out in 18 specific pathogens-free and age-matched (7- to 10-week-old) male Wister albino mice. Paracetamol toxicity was induced by the dose of 1gm/kg. The dose of leaf extract was 200mg/kg orally once day daily for 7 days. After the 18th day, all experimental animals were anesthetized and dissected. Animals were divided into 3 groups. In the Biochemical parameter study control group showed a normal range of AST, ALT, and Bilirubin levels while group II showed elevated levels of AST, ALT, and bilirubin. Confirming the paracetamol causes liver injury at higher doses. In treated group showed much lower levels of AST, ALT, and bilirubin than group II but higher than those of the control group. So based on these observations researchers concluded that *Clitoria ternatea* Linn leaf extract possessed strong hepatoprotective and antioxidant activity in a mice model of paracetamol-induced hepatotoxicity.

Patil et al.,2011 (13) in this study both varieties of flowers (white& blue) with seeds of *Clitoria ternatea* Linn were examined for their Antioxidant action. For this, they used Petroleum ether, Chloroform, and methanol extracts of seeds of Blue and White flowered varieties of *Clitoria ternatea* Linn. These extracts were studied for DPPH free radical scavenging assay, reducing power assay, and hydroxyl radical scavenging assay. Methanolic extract of the White flowered variety of seed of *Clitoria ternatea* Linn showed better antioxidant activity as compared to a blue flowered variety of *Clitoria ternatea* Linn. So white flowered variety of *Clitoria ternatea* Linn may be a good source of natural antioxidants.

Hypoglycemic Effect of *Clitoria ternatea* Linn.

Daisy and Rajathi., 2009 (14) Evaluated the effect of aqueous extracts of *Clitoria ternatea* Linn leaves and flowers on serum Glucose and Glycosylated hemoglobin in Diabetic rats. The study drug was administered orally in the dose of 400mg/kg body weight while Insulin was used as a standard drug. The extract was administered over 84 days. In this study, male adult Wister strain albino rats were used. Administration *of Clitoria ternatea* Linn leaves extract and *Clitoria ternatea* Linn flower extract to diabetic rats significantly decreased the levels of blood glucose and glycosylated hemoglobin and at the same time increased serum insulin. There is also a decrease in the level of glycosylated hemoglobin in alloxan-induced diabetic rats following *Clitoria ternatea* Linn leaves and flower therapy, indicating that the overall blood glucose level was controlled. This effect may be because of increased Insulin secretion in the blood.

In another study, Daisy et al.,2009 (15) evaluated the effect of *Clitoria ternatea* Linn leaves (CTL) and flower (CTF) extract as an Antihyperglycemic and antihyperlipidemic agent. For this study, male adult Wister albino rats were used. The doses of CTL and CTF were given at 400mg/kg body weight. The result of the present investigation indicates that leaf and flower extract of *Clitoria ternatea* Linn have a Hypoglycemic effect on Alloxan-induced diabetic rats and the extract was highly effective in managing the complications associated with Diabetes, such as Hypercholesterolemia, Hypertriglyceridemia, and impaired renal function.

Saxena et al.,2013 (16) use Ethanolic extract of *Clitoria ternatea* Linn leaves for this study. The standard drug used for the study was Glibenclamide (10mg/kg in vehicle). Glucose level was estimated on overnight fasted rats at 0 hours, 1 hour, 2 hours, and 3 hours. In this study, the methanolic extract of the drug showed a marked effect in decreasing the blood glucose level. In the glucose tolerance test, methanolic extract of 400 mg/kg showed a significant effect on the blood glucose level but extract of 200mg/kg did not show a significant decrease in blood glucose level.

Anthelmintic Effect of *Clitoria Ternatea* Linn .

Kamrun et al.,2011 (17) produced fresh juice extract from the leaf of *Clitoria ternatea* Linn. The anthelmintic assay was performed on adult earthworm, Pheretima posthuma. These worms have anatomical and physiological resemblance with intestinal roundworm parasites of human beings. This study proves the anthelmintic activity of juice extract from the leaves of *Clitoria ternatea* Linn. However, this study was an in vitro study, so further research is required.

Khadatkar et al.,2008 (18) evaluate the anthelmintic activity of crude alcoholic extract of *Clitoria ternatea* Linn. The worms used were Pheretima posthuma. Piperazine citrate was induced as a standard drug. Alcoholic extract of *Clitoria ternatea* Linn and its different fractions exhibited anthelmintic activity in dose dose-dependent manner giving the shortest time of paralysis and death with 50mg/ml concentration. In this study paralysis and death of worms occurred at 4.27 min & 10.58 min respectively when an Alcoholic extract of the leaf of *Clitoria ternatea* Linn was used. Whereas, ethyl acetate and methanol fractions revealed paralysis at 6.28min and 5.6min and time of death at 21.59 and 11.92min respectively. Standard drug piperazine citrate showed paralysis and death at 19.26 min and 63.25 min respectively. According to this study alcoholic extract of *Clitoria ternatea* Linn roots showed significantly determined anthelmintic activity.

Diuretic Effect of *Clitoria Ternatea* Linn.

Jayanthi et al.,2021 (19) assessed the Diuretic and Antioxidant activity of *Clitoria ternatea* Linn. Leaf extract was used for this study. Extracts used were chloroform extract of leaf of *Clitoria ternatea* Linn (CCTL), methanol extract of leaf of *Clitoria ternatea* Linn (MCTL), and aqueous extract of leaf of *Clitoria ternatea* Linn (ACTL). Male Wister rats 8 to 10 weeks old were used for animal experiments. For the evaluation of the Diuretic activity of *Clitoria ternatea* Linn, the Lipschitz model was used. A study drug with

three different extracts MCTL, ACTL, and CCTL with dosages of 150 mg, 300 mg, and 450 mg for each extract, respectively was used. The diuretic activity was maximum in the MCTL extract over that of either ACTL or CCTL extracts, as well as the standard drug. The antioxidant potential of the extract was evaluated using the DPPH (2,2-Diphenyl-1- picrylhydrazyl) radical scavenging capacity and Ferric- reducing antioxidant power (FRAP) method. According to this study leaf extract of Clitoria ternatea shows strong antioxidant activity, so can be used in diseases like hypertension and edema.

Antibacterial Effect of *Clitoria Ternatea* Linn .

Anand et al.,2011 (20) evaluated the antibacterial properties of *Clitoria ternatea* Linn. For this, they used organic solvent (Petroleum ether, Ethyl acetate, and methanol) extracts from the leaves. The extract was tested against Bacillus cereus, Staphylococcus aureus, Klebsiella pneumonia, Proteus vulgaris, and Salmonella typhi by agar disc and well diffusion methods. The results of this study were that methanolic extract affected the activity of Bacillus cereus to a greater extent followed by Klebsiella pneumonia, Proteus vulgaris, and Salmonella typhi. Petroleum ether extract affected the activity of salmonella typhi to a great extent followed by Proteus vulgaris, Bacillus cereus, and Klebsiella pneumoniae.

Das et al.,2014 (21) studied the antimicrobial potentiality of Petroleum ether, Chloroform, Benzene, and 50% Aqueous ethanol leaf extract of *Clitoria ternatea* Linn, against the Serratia marcescens, Erwinia herbicola, Xanthomonas spp, Arthrobacter chlorophenolicus and Antifungal property against the Botrytis cinerea, Fusarium oxysporum, Rhizoctonia solani, Aspergillus flavus. Antibacterial assay was done by the Cup diffusion method. According to this assay, 50% aqueous Ethanolic leaf extract of *Clitoria ternatea* Linn possessed antibacterial properties against Serratia marcescens, Arthrobactor chlorophenolicus, and Antifungal properties against fusarium oxysporum.

Uma et al.,2009 (22) screened the antimicrobial activity of various extracts of *Clitoria ternatea* Linn flower against some ESBL (Extended Spectrum Beta Lactamase) producing Enteric and Urinary pathogens isolated from patients. Aqueous, Methanol, Chloroform, petroleum ether, and hexane extract were used for the study. Disc diffusion and a two-fold serial dilution method were used to evaluate the antimicrobial activity. Antimicrobial activity was carried against Uro-pathogenic E. coli, Enterotoxigenic E. coli, Enteropathogenic E coli, Salmonella typhimurium, Salmonella Enteritidis, Klebsiella pneumoniae and Pseudomonas aeruginosa isolated from patients with urinary tract infection and acute gastroenteritis. The antimicrobial assay showed that aqueous, methanol, and chloroform extracts of *Clitoria ternatea* Linn blue flowers exhibited activities against uropathogenic E. coli, Enterotoxigenic E coli, Enteropathogenic E coli, Klebsiella pneumoniae, and Pseudomonas aeruginosa. No activity was observed against salmonella typhimurium and salmonella Enteritidis. Methanol extract of *Clitoria ternatea* Linn has a higher antibacterial effect than other extracts. While Petroleum ether and hexane extracts do not show any antibacterial activity.

Rao et al.,2017 (23) aimed to find out the antimicrobial activity of aqueous and alcoholic extract of *Clitoria ternatea* Linn root against Pseudomonas aeruginosa, E. coli, clinical strains of Klebsiella pneumonia and Candida albicans. The Agar well diffusion method was done using Mueller Hinton agar and Sabourauds dextrose agar. The root of *Clitoria ternatea* Linn aqueous extract with a concentration of 100ug/ml showed a zone of inhibition against E coli 18mm, P. aeruginosa 14 mm, and multidrug-resistant strain of K pneumoniae 15mm. Alcoholic extract of root with a concentration of 100ug/ml showed a zone of inhibition of 35mm against E coli, P. aeruginosa 22mm multidrug-resistant strain of K pneumoniae 28mm. C albicans was resistant to both aqueous and alcoholic extract of *Clitoria ternatea* Linn root. There is a decrease in the zone of inhibition with a decrease in concentration which is statistically significant. Comparison of the zone of inhibition between the aqueous and alcoholic extract for each concentration depicted a statistically significant difference in the means for the concentration of 100, 50, and 25ug/ml ($P<0.001$) for E coli, P aeruginosa, and MDR k Pneumoniae and the concentration of 12.5ug/ml the aqueous extract was resistant to all the organisms used in the test.

Antiasthmatic Activity of *Clitoria Ternatea* Linn.

Chauhan et al.,2012 (24) evaluated the antiasthmatic activity and antioxidant effect of ethanol extract of *Clitoria ternatea* root. The study was carried out on Wistar albino rats of 4 months of both sexes, weighing between 100 to 150gm. Bronchospasm was induced by Histamine aerosol in Wistar rats. The test drug was used in a dose of 400mg/kg. The results obtained in this study demonstrate that the extracts of *Clitoria ternatea* Linn showed antiasthmatic activities against histamine-induced bronchoconstriction. The antiasthmatic activity shown by the plant may be because of the presence of flavonoids, the steroidal nucleus in the form of triterpenoids, and various saponin glycosides.

Anticancer Effect of *Clitoria Ternatea* Linn.

Das et al.,2020 (25) studied the Antibacterial and anticancer effects of the Methanol extract of *Clitoria ternatea* Linn. The cytotoxic assay was done by using MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl-2H-tetrazoliumbromide) assay method. This MTT assay showed slight to severe cytotoxic reactivity to HL60 cells. The cell death increased with an increase in the concentration of the extract. It shows that *Clitoria ternatea* Linn leaves methanol extract has bioactive compounds showing anticancer activity against HL 60 cells. Antibacterial assay was done by using the Agar well diffusion method. The extract was tested against bacterial strains such as Streptococcus agalactiae, Salmonella typhi, Staphylococcus aureus, Enterobacter

aerogenes, Escherichia coli, and Bacillus subtilis. Ampicillin was used as a positive control. 50% of the extract and 100% of the leaf extract was used as two different study drug. The results of this study suggested that the *Clitoria ternatea* Linn extract showed greater resistance to Salmonella typhi and can be used to treat diseases caused by Salmonella typhi.

Antidepressant Effect of *Clitoria Ternatea* Linn.

Parvathi et al.,2013 (26) assess the Antidepressant, Motor coordination, and Locomotor activities of Ethanolic root extract of *Clitoria ternatea* Linn in experimental animals. Animals used were Swiss albino mice and albino rats of either sex. The experimental drug used was Ethanolic root extract of *Clitoria ternatea* Linn in doses of 150mg and 300mg/kg. The standard drugs used were Imipramine and Diazepam. Evaluation of Antidepressant activity was done by Tail suspension test (TST) and Forced swim test (FST). Evaluation of motor coordination was done in the Rota rod apparatus. Evaluation of Locomotor activity was recorded individually for 10 min using an Actophotometer. In both TST and FST, *Clitoria ternatea* Linn (150mg and 300mg/kg p.o) produced significant reduction ($P<0.001$ and $P<0.001$) respectively in the immobility period when compared with that of control group animals that received only the vehicle. The extract in a dose of 300mg/kg was found to be effective and it exhibited activity like that of the conventional drug Imipramine ($P<0.001$)

In the muscle coordination test *Clitoria ternatea* Linn at a dose of 300mg/kg only slightly reduced the time spent by the animals on the revolving rod when compared with control, indicating mild muscle relaxant activity. *Clitoria ternatea* Linn (300mg/kg only) exhibited a slight reduction in locomotor activity when compared with control animals. From the above study, we can conclude that Ethanolic root extracts of *Clitoria ternatea* Linn show significant Antidepressant activity in TST and FST models of depression.

Jain et al.,2003 (27) evaluate the spectrum activity of *Clitoria ternatea* Linn on the CNS. Male albino mice were used for the study. For evaluation of Antidepressant action Tail suspension test was done. The dose of *Clitoria ternatea* Linn used was 100mg/kg and 400mg/kg. The standard drug used was Fluoxetine in a dose of 10mg/kg. the duration of Immobility in the tail suspension test was markedly reduced by the administration of Clitoria ternatea extract.

Malik et al.,2011 (28) confirm the true source of *Shankhpusphi*. Different plants were used as *Shankhpusphi* in different parts of India. Commonly *Convolvulus pluricaulis* Chois, *Evolvulus alsinoides* Linn, and *Clitoria ternatea* Linn are used as *Shankhpusphi*. With this Anxiolytic, Antidepressant, and CNS depressant actions of these plants were also evaluated. For this Roots of *Clitoria ternatea* Linn was used in the dose of 50,100,200 and 400mg/kg. Imipramine at the dose of 12.5mg/kg was used as the standard drug. Laca mice of either sex were used for animal experimentation. Porsolt's swim despair test was used for the evaluation of antidepressant action. There was a decrease in immobility period after administration of *Clitoria ternatea* Linn root extract.

Table 1: Summary

Pharmacological	No of	Part	Animals used	Dose of drug	Test for	The difference in result of
Analgesic	2	Leaf	Swiss albino mice	200mg & 400mg/kg body wt	Writhing test	Writhing inhibitory effect at 87.87% at 400mg dose 82.67% at 200mg dose
					Hole cross and Open	Depressing action at 60mins to 120min observation period
		Flower	Albino mice	200mg & 400mg/kg	Eddy's hot plate method	Analgesic activity was exhibited at the dose level 400mg/kg body wt. (Mean
Hepatoprotective & Antioxidant	3	Leaf	Albino rats	100mg/kg	CCl_4 induced Hepatic toxicity	Decrease in the level of AST,ALT,ALP,ACP,LDHtotal bilirubin, conjugated bilirubin is found more in standard drug (Silymarin) than ethanol
		Leaf	Male Wister albino mice	200mg/kg body wt	Paracetamol toxicity 1gm/kg body wt. Antioxidant activity	*Clitoria ternatea* treatment decreases the level of AST, ALT and bilirubin in paracetamol induced Hepatotoxicity in mice. Percentage of free Radical
		Seeds	In vitro	50-600 µg/ml,	DPPH radical scavenging assay, Reducing scavenging	Methanolic extract of White flowered variety of seed of *Clitoria ternatea* showed better antioxidant activity as compared to blue flowered

Hypoglycemic	3	Leaves, Flower	Male wistar albino rats	400mg/kg body wt	Alloxan-induced diabetes mellitus in rats Level of serum	significantly decreased the level of blood glucose and Glycosylated hemoglobin, increased serum insulin to nearcontrol level.
		Leaves, Flower	Male wistar albino rats	50mg.kg to 500mg/ kg body wt	Alloxan-induced diabetes mellitus in rats Level of serum Glucose ,	leaf and flower extract of *Clitoria ternatea* have Hypoglycemic effect and highly effective in managing the complication associated with Diabetes, such as Hypercholesterolemia,
		Leaves	Male albino rats	200mg & 400mg/ kg	Alloxan-induced diabetes mellitus in	Methanolic extract 400 mg/kg showed significant effect on the blood glucose level but extract of 200mg/kg did not
Anthelmintic	2	Leaf	Pheretimaposthuma earth worm	25mg/ml,50mg/ml 100mg/ml	Anthelmintic activity	leaves of *Clitoria ternate* Linn displayed profound
		Root	Pheretimaposthuma earth worm	10mg/ml 25mg/ml 50mg/ml	Anthelmintic activity	Alcoholic extracts of *Clitoria ternatea* roots have significantly determined anthelmintic
Diuretic	1	Leaf	Male wistar rats	150 mg, 300 mg, and 450 mg	Diuretic activity	The diuretic activity was maximum in the MCTL extract over that of either
Antibacterial	4	Leaf	Bacteria	-	Antibacterial activity by Agar disc diffusion method, well diffusion method	Methanolic extract affected the activity of Bacillus cereus to a greater extent followed by Klebsiella pneumonia, Proteus vulgaris and Salmonella typhi. Petroleum ether extract affected the activity of
		Leaf	Bacteria and fungus	-	Agar cup diffusion method	Ethanolic leaf extract of *Clitoria ternatea* Linn possessed the antibacterial property against Serratia marcescens, Arthrobactor
		Flower	ESBL producing enteric and urinary pathogens.	-	Disc diffusion and two-fold serial dilution method	Methanol extract of *Clitoria ternatea* have high antibacterial effect than other extracts. While Petroleum
		Root	Gram-negative bacteria & multidrug resistant strain of *Klebsiella*	-	Agar well diffusion method	*C. ternatea* was effective against *K. pneumoniae*.
Antiasthmatic	1	Root	Wister albino rats Histamine Aerosol induced Bronchospasm	400mg/kg	time required for appearance of pre-convulsive	*Clitoria ternatea* showed antiasthmatic activities against histamine induced bronchoconstriction
Anticancer	1	Leaves	Human promyelocytic leukemia cell	-	MTT Assay	*Clitoria ternatea* leaves methanol extract has bioactive compounds showing
Antidepressant	3	Root	Swiss albino mice and albino rats	150mg &300mg/kg body wt	Tail suspension test (TST)	Ethanolic root extracts of *Clitoria ternatea* show a significant Antidepressant
		Leaf & Flower Root	Male albino mice Laca mice of either sex	100mg & 400mg/ kg 50,100,200 & 400mg/kg	Tail suspension test Porsolt's swim despair	Duration of immobility markedly reduced. Duration of immobility period decreases.

Discussion

Pharmacologically *Aparajita* is Nootropic, Anxiolytic, anticonvulsant, anti-diabetic, anti-inflammatory, and analgesic along with it enhances memory and has antidepressant activity. According to a database on medicinal plants used in Ayurveda published by CCRAS, *Aparajita* has cholinergic action. (29) Chemicals present in *Clitoria ternatea* Linn are tannins, phlorotannin, carbohydrates, saponin, triterpenoids, phenols, flavonoids, flavanol glycosides, proteins, alkaloids, anthraquinone, anthocyanins, cardiac glycosides, stignast-4-ene-3, 6-dione, volatile oils, and steroids. (30)

Aparajita is mentioned in almost all Ayurvedic classical texts and mentioned in the treatment of snake bites and poisoning. Important formulations of Aparajita that are described in poisoning are, *Meghnaad agad* (31), *Rushabhakaadi agad* (32), *Param agad* (33), *Amrita ghrita* (34) etc. *Aparajita* is also part of some Ayurvedic medicinal formulations which are used in various pathological conditions like *Garbhapala rasa* (35). *Suvarna Makaradhwaja* (36), *Somaraji tail* etc. Therapeutically *Aparajita* is used in asthma, burning sensation, ascites, inflammation, leukoderma, leprosy, hemicranias, amentia, pulmonary tuberculosis, urogenital disorders, etc.

The chemical constituents of Aparajita are:

In roots- Taraxerol and taraxerone, pentacyclic triterpenoids and flavonol glycoside, 3,5,4′-trihydroxy-7-methoxyflavonol-3-O-β-d-xylopyranosyl-(1,3)-O-β-d-galactopyranosyl (1,6)-O-β-d-glucopyranoside. [7-9].

In seeds- Besides protein and fatty acid content, seeds also contain p-hydroxycinnamic acid, β-sitosterol, γ-sitosterol adenosine, flavonol-3-glycoside, ethyl-α-d-galactopyranoside, 3,5,7,4′-tetrahydroxyflavone, 3-rhamnoglucoside, hexacosanol, and an anthoxanthin glucoside [10-14]. Kelemu et al. [15] reported the presence of antimicrobial and insecticidal protein finotin in the seeds of CT.

In flowers- The flowers of CT contain ternatins A1-3, B1-4, C1-5, D1-3 [16-24]. The flowers of CT also contain kaempferol, kaempferol 3-neohesperidoside, kaempferol 3-2G-rhamnosyl rutinoside, kaempferol 3-rutinoside

In the present study, it is observed that Leaves, flowers, seeds, and roots of *Aparajita* have therapeutic potential. Eleven preclinical studies conducted on Leaves have proved that they possess Analgesic, Hepatoprotective, Antioxidant, Hypoglycemic, Anthelmintic, Diuretic, Antibacterial, anti-cancer and Antidepressant properties. Five preclinical studies conducted on flowers have proved that they possess Analgesic, Hypoglycemic, Antibacterial, and Antidepressant properties. One preclinical study conducted on seed has proved that it possesses Hepatoprotective and Antioxidant properties. Five preclinical studies conducted on root have proved that it possesses Anthelmintic, Antibacterial, Antiasthmatic, and Antidepressant properties.

Based on the ancient ayurvedic literature and the pre clinical trials, there are various areas were the potentials of *Clitoria ternatea* can gain therapeutical gains. Further studies working on its mode of action, target prediction and its metabolism in the body can be helpful in development of a useful therapeutic drug having multiple benefits.

Conclusion

In classical Ayurvedic texts, *Clitoria ternatea* Linn was described as an important medicinal drug efficacious in various diseases and described as one of the important ingredients of various Ayurvedic formulations. It is indicated in asthma, burning sensation, ascites, inflammation, leukoderma, leprosy, hemicranias, amentia, pulmonary tuberculosis, urogenital disorders, etc. In the contemporary view also number of pharmacological studies and preclinical studies prove the effectiveness of *Clitoria ternatea* Linn in various conditions like Analgesic, Hepatoprotective, Antioxidant, Hypoglycemic, Anthelmintic, Diuretic, Antibacterial, anti-cancer and Antidepressant properties and Hepatoprotective properties. Five preclinical studies conducted on root have proved that it possesses Anthelmintic, Antibacterial, Antiasthmatic, and Antidepressant properties. From this systemic review it can be suggested that further clinical research can be conducted to establish the therapeutic potential of drug, *Aparajita.*

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