

A REVIEW ON THE PHYTOCHEMICAL AND PHARMACOLOGICAL POTENTIAL OF *CUSCUTA REFLEXA* AND *TINOSPORA CORDIFOLIA* FOR POLYHERBAL SYRUP DEVELOPMENT

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ABSTRACT

Medicinal plants represent an important source of bioactive compounds and have been extensively investigated for their therapeutic applications. *Cuscuta reflexa* Roxb. and *Tinospora cordifolia* are traditionally used medicinal plants possessing diverse phytochemical constituents and pharmacological properties. The present review focuses on the phytochemical profile, relevant pharmacological activities, safety aspects and formulation potential of these two plants for development of a polyherbal syrup. *Cuscuta reflexa*, commonly known as Amarbel, is a parasitic plant traditionally used for conditions such as cough, cold and asthma. Reported phytoconstituents include flavonoids, saponins, steroids, triterpenoids and other secondary metabolites. Experimental investigation of its ethanolic extract demonstrated mast-cell stabilizing activity in sensitized rats. At oral doses of 50 and 100 mg/kg, the extract produced 64.40% and 72.30% intact mast cells, respectively, compared with 84.50% in the prednisolone-treated group. *Tinospora cordifolia*, commonly known as Guduchi or Giloy, belongs to the family Menispermaceae and contains alkaloids, diterpenoids, glycosides, steroids, flavonoids, phenolics and polysaccharides. Several studies have reported antibacterial activity of its extracts against Gram-positive and Gram-negative bacteria, including clinically relevant and multidrug-resistant organisms. "However, the efficacy, safety and possible interaction between the extracts of the combined formulation need to be established through systematic formulation, standardization and pharmacological studies."

1. INTRODUCTION

Medicinal plants have played an important role in traditional healthcare systems and continue to be investigated as potential sources of therapeutic agents. Their biological effects are mainly associated with secondary metabolites such as alkaloids, flavonoids, glycosides, terpenoids, steroids, saponins, tannins and phenolic compounds. The increasing interest in herbal medicines has encouraged scientific investigation of traditionally used plants to establish their pharmacological activities, safety and possible pharmaceutical applications.^[4,7]

Histamine is an important mediator involved in allergic responses. Mast cells act as major storage sites for histamine and other mediators and undergo degranulation

following activation. Stabilization of mast cells can therefore reduce mediator release and is an important experimental approach for investigating antihistaminic or mast-cell stabilizing activity.^[1]

Cuscuta reflexa Roxb. is a parasitic medicinal plant traditionally associated with the management of cough, cold and asthma. Its phytochemical investigations have demonstrated the presence of flavonoids, saponins, steroids, triterpenoids and other compounds. Experimental studies have reported mast-cell stabilizing activity of its ethanolic extract in sensitized rats.^[1,10,11]

Tinospora cordifolia is a well-known medicinal plant belonging to the family Menispermaceae. It is commonly known as Guduchi or Giloy and has been extensively investigated because of its broad phytochemical and pharmacological profile. Alkaloids, diterpenoids, glycosides, steroids, flavonoids, phenolic compounds and polysaccharides have been reported from different parts of the plant. Its antibacterial activity against several bacterial species has also been investigated.^[2,4,7]

The complementary relevance of these two medicinal plants provides a basis for investigating their combination in a polyherbal syrup. The proposed formulation may provide an opportunity to evaluate mast-cell stabilizing and antibacterial activities in a single herbal dosage form.^[3,8,9]

“Although both plants have been investigated individually for various biological activities, limited information is available regarding their combined use in a polyherbal syrup specifically intended for evaluation of mast-cell stabilizing and antibacterial activities. Therefore, a systematic review of their phytochemical composition, relevant pharmacological evidence and safety profile is important before development and evaluation of such a formulation.”

2. BOTANICAL DESCRIPTION

2.1 *Cuscuta reflexa*

Cuscuta reflexa Roxb. is a parasitic, twining plant commonly known as Amarbel or Dodder. It develops slender, thread-like stems and depends on host plants for nutrients. Due to its parasitic nature, it lacks well-developed leaves and obtains nutrients through specialized structures that penetrate the host.^[10,11]

Taxonomical classification

Taxonomic parameter	Description
Kingdom	Plantae
Genus	Cuscuta
Species	C.reflexa
Family	Cuscutaceae
Common name	Amarbel, Dodder, Kokli
Habit	Parasitic twining herb

The plant has been traditionally used for several medicinal purposes, with cough, cold and asthma being

particularly relevant to the present review.

2.2 *Tinospora cordifolia*

Tinospora cordifolia is a perennial climbing shrub belonging to the family Menispermaceae. It is widely known as Guduchi, Giloy or Amrita and is an important medicinal plant in Ayurveda.

Taxonomical classification

Taxonomic parameter	Description
Kingdom	Plantae
Genus	<i>Tinospora</i>
Species	<i>T.cordifolia</i>
Family	Menispermaceae
Common name	Guduchi, Giloy, Amrita
Habit	Climbing shrub/vine

The stem is one of the most extensively investigated plant parts because of its rich phytochemical composition.

3. PHYTOCHEMICAL PROFILE

3.1 Phytochemistry of *Cuscuta reflexa*

Phytochemical investigations indicate the presence of several classes of secondary metabolites in *C. reflexa*. The major reported groups include.^[1,10,12]

- Flavonoids Saponins
- Triterpenoids
- Alkaloids
- Phenolic compounds Coumarins

Some reported constituents include quercetin, kaempferol, myricetin, β -sitosterol, stigmasterol and oleanolic acid.^[1,10,12]

The ethanolic extract used in the mast-cell study showed flavonoids, saponin glycosides, steroids and triterpenoids during preliminary phytochemical screening. The presence of flavonoids and saponins was considered relevant to the observed biological activity.^[1]

3.2 Phytochemistry of *Tinospora cordifolia*

T. cordifolia possesses a chemically diverse phytochemical profile. The major phytochemical classes reported from the plant include.^[2,4,7,13]

Phytochemical class	Representative constituents
Alkaloids	Berberine, Palmatine, Jatrorrhizine, Magnoflorine
Diterpenoids	Tinosporaide, Tinospirin, Columbin, Jateorine
Glycosides	Tinocordiside, Tinocordifolin, Cordifoliosides
Steroids	β -Sitosterol, Ecdysterone, Gilo-insterol
Flavonoids	Various flavonoid constituents
Phenolics	Phenolic compounds
Polysaccharides	Various polysaccharide fractions

This diverse chemical composition is considered to contribute to the broad pharmacological profile of the

plant.

4. PHARMACOLOGICAL RELEVANCE OF CUSCUTA REFLEXA

4.1 Mast-cell stabilizing activity

The antihistaminic relevance of *C. reflexa* has been experimentally investigated using an ethanolic extract of the whole plant.^[1]

In the reported study, the plant material was dried, powdered and extracted with ethanol using Soxhlet

extraction. Male Wistar albino rats weighing approximately 150–200 g were used. The experimental animals were sensitized and treated orally with the extract at 50 and 100 mg/kg. Prednisolone at 10 mg/kg was used as the reference treatment.^[1]

Mast cells were evaluated after staining with toluidine blue. The percentage of intact mast cells was used as an indicator of mast-cell stabilization.^[1]

Reported Findings

Treatment	Dose	Intact mast cell
Sensitized control	--	15.50 ± 2%
<i>C. reflexa</i> extract	50 mg/kg	64.40 ± 2%
<i>C. reflexa</i> extract	100 mg/kg	72.30 ± 2%
Prednisolone	10 mg/kg	84.50 ± 2%

The 100 mg/kg dose demonstrated greater mast-cell stabilization than the 50 mg/kg dose. Although the effect was lower than that observed with prednisolone, the results indicated the potential of *C. reflexa* ethanolic extract to protect mast cells under the experimental conditions.^[1]

The authors suggested that flavonoids and saponins may contribute to the observed activity. However, the exact active constituents and molecular mechanism require further investigation.^[1]

5. PHARMACOLOGICAL RELEVANCE OF TINOSPORA CORDIFOLIA

5.1 Antibacterial activity

Antibacterial activity is one of the important pharmacological properties relevant to the proposed polyherbal formulation. Different extracts of *T. cordifolia* have been investigated against a range of bacterial species.^[3,8,9]

Reported organisms include

- Escherichia coli
- Staphylococcus aureus Proteus vulgaris
- Klebsiella pneumoniae
- Pseudomonas aeruginosa
- Salmonella species
- Shigella flexneri
- Enterobacter species Serratia species

The antibacterial response differs according to the plant part, extraction solvent, extract concentration and bacterial strain.^[3,8,9]

5.2 Activity of different extracts

Aqueous, ethanolic and chloroform extracts of *T. cordifolia* have been evaluated by agar diffusion methods. The ethanolic extract demonstrated notable activity against organisms such as *E. coli* and *Proteus vulgaris*, while activity against other organisms varied.

These findings indicate that the extraction solvent can influence the concentration and type of bioactive

constituents obtained from the plant.^[3,8,9]

5.3 Activity against multidrug-resistant bacteria

The antibacterial potential of *T. cordifolia* has also been investigated against multidrug-resistant clinical isolates. Studies involving MRSA, VRE and ESBL-producing organisms reported that ethanol and chloroform extracts generally demonstrated better antibacterial activity than aqueous extracts against several tested isolates.^[9]

This evidence increases the interest in *T. cordifolia* as a source of antibacterial phytochemicals. Nevertheless, laboratory antibacterial activity should not be equated with clinical efficacy.^[3,8,9]

6. OTHER PHARMACOLOGICAL ACTIVITIES OF TINOSPORA CORDIFOLIA

Several other biological activities have been reported for *T. cordifolia*, including.^[2,5,7]

- Antioxidant Antidiabetic Antipyretic
- Hepatoprotective
- Antidiarrheal
- Antiulcer
- Neuroprotective Antimicrobial

These activities demonstrate the broad pharmacological importance of the plant. However, antibacterial activity remains the primary pharmacological relevance of *T. cordifolia* in the proposed project.^[2,9]

7. SAFETY AND TOXICITY

7.1 Cuscuta Reflexa

Experimental studies have investigated *C. reflexa* extracts at different doses. The mast-cell study used 50 and 100 mg/kg orally in rats under appropriate ethical supervision.^[1]

Although some studies have reported no major acute toxicity at higher experimental doses, toxicity is dependent upon the extract, dose, route, plant part and duration of treatment.^[1,10,12]

Therefore, safety of the final formulation must be

established independently.^[1,10,12]

7.2 *Tinospora Cordifolia*

T. cordifolia has demonstrated acceptable tolerance in several experimental studies. However, the available safety evidence is not sufficient to regard every preparation of the plant as completely risk-free.^[2,5,7]

“Some reports have raised concerns regarding possible hepatotoxic effects associated with *Tinospora cordifolia* use; however, species authentication and product composition should be considered when interpreting these reports. Hence, authentication, standardization, dose selection, and appropriate toxicity evaluation will be important during formulation development.^[2,5,7]”

8. RELEVANCE OF BOTH PLANTS IN POLYHERBAL SYRUP

The proposed selection of *Cuscuta reflexa* and *Tinospora cordifolia* will be based on their reported phytochemical composition and pharmacological properties. The two plants will be considered for a polyherbal syrup because they have been reported to possess different biological activities that will be relevant to the proposed antihistaminic and antibacterial investigation. The available literature will provide the scientific basis for selecting these plants, while the activity of their combined formulation will be determined through further experimental studies.^[1,11]

8.1 Relevance of *Cuscuta reflexa*

Cuscuta reflexa will be considered as an important herbal component of the proposed formulation because of its diverse phytochemical composition and reported pharmacological properties. Different phytochemical groups reported from the plant will include flavonoids, saponins, steroids, triterpenoids, alkaloids, phenolic compounds and coumarins. Important reported constituents will include flavonoids such as quercetin, kaempferol and myricetin; steroids such as β -sitosterol and stigmasterol; and triterpenoids such as oleanolic acid.^[1,10,11]

The reported phytochemical diversity of *C. reflexa* will provide a basis for its further pharmacological investigation. Previous experimental work has reported mast-cell stabilizing activity of an ethanolic whole-plant extract of *C. reflexa*. Since mast-cell stabilization is associated with reduced release of mediators such as histamine, this finding will provide a basis for investigating the antihistaminic/mast-cell stabilizing relevance of *C. reflexa* in the proposed polyherbal syrup.^[10,11]

However, the contribution of individual phytoconstituents to the reported activity will not be assumed without experimental evidence. Therefore, *C. reflexa* will be investigated as one of the herbal components of the proposed formulation, and its contribution to the intended antihistaminic/mast-cell

stabilizing activity will be evaluated experimentally.

8.2 Relevance of *Tinospora cordifolia*

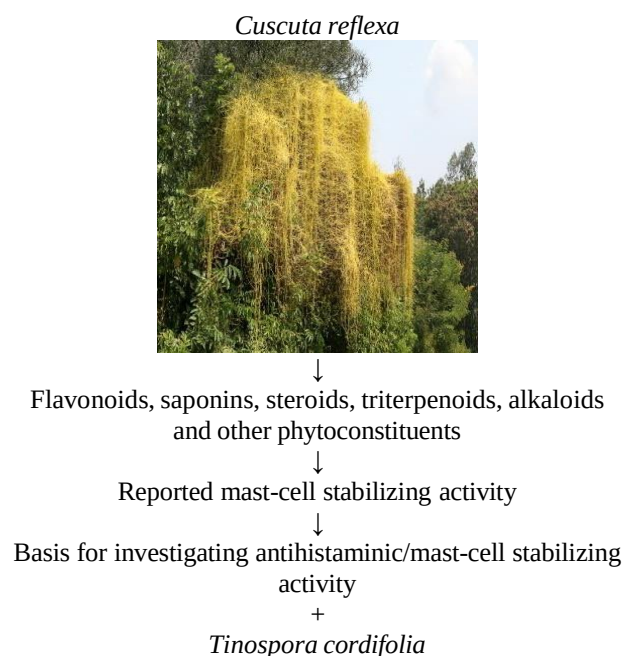
Tinospora cordifolia will be included as the second herbal component because of its wide range of reported phytoconstituents and pharmacological activities. The plant will be reported to contain alkaloids, diterpenoids, glycosides, steroids, flavonoids, phenolic compounds and polysaccharides. Important reported constituents will include alkaloids such as berberine, palmatine, jatrorrhizine and magnoflorine; diterpenoid compounds such as columbin and jateorine; and glycosides such as tinocordiside, tinocordifolin and cordifoliosides.^[2,9]

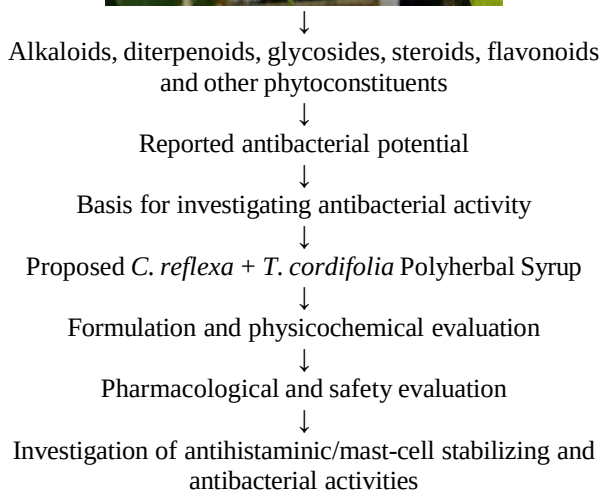
Different extracts of *T. cordifolia* will be considered in the literature for their reported antibacterial activity against various bacterial organisms. The observed activity may differ according to the plant material, plant part, extraction method, solvent, extract concentration and bacterial strain used in the study.^[2-9] Therefore, the antibacterial activity reported for a particular extract will not be directly considered as the activity of the proposed polyherbal syrup.

In the present work, *T. cordifolia* will therefore be investigated for its antibacterial relevance in the proposed formulation. The antibacterial activity of the final polyherbal syrup will be evaluated using suitable experimental methods, and the results will be interpreted according to the selected organisms and experimental conditions.^[3,8,9]

8.3 Relevance of the Proposed Polyherbal Combination

The proposed combination of *Cuscuta reflexa* and *Tinospora cordifolia* will be considered on the basis of their reported phytochemical diversity and different areas of pharmacological relevance.^[1,13]





The combination of *C. reflexa* and *T. cordifolia* will provide a basis for developing and investigating the proposed polyherbal syrup. The formulation will be subjected to appropriate optimization, standardization,

physicochemical evaluation, stability assessment and safety evaluation before its pharmacological properties are interpreted. The proposed combination will therefore be considered as an area for experimental investigation rather than as an already established therapeutic combination.^[1,13]

Although both plants contain several biologically active phytoconstituents, the presence of these constituents will not by itself establish synergistic activity between the two plants. Any synergistic or combined effect will need to be demonstrated through appropriate experimental studies and comparative evaluation. Thus, the proposed formulation will be evaluated experimentally to determine its antihistaminic/mast-cell stabilizing and antibacterial potential.^[1,11]

9. FORMULATION CONSIDERATIONS

A polyherbal syrup is a liquid oral dosage form that can provide convenient administration of herbal extracts. Potential formulation components include.

- *C. reflexa* extract
- *T. cordifolia* extract
- Sweetening agent
- Vehicle
- Preservative
- Flavouring agent
- Colouring agent, if necessary
- Stabilizing agent, if required

The ratio and concentration of the two herbal extracts should be determined and optimized experimentally based on the intended formulation and evaluation parameters. Animal doses reported in individual literature studies should not be directly considered as formulation concentrations without appropriate dose conversion and formulation-based justification.^[1,13]

10. EVALUATION OF THE FORMULATION

The proposed polyherbal syrup may be evaluated for.

Evaluation parameter	Observation
1. Colour	Organoleptic evaluation
2. Odour	Organoleptic evaluation
3. Taste	Organoleptic evaluation
4. Appearance	Visual evaluation
5. PH	pH determination
6. Viscosity	Viscosity determination
7. Specific gravity	Specific gravity determination
8. Physical stability	Physical changes during storage
9. Microbial quality	Microbiological evaluation
10. Stability	Physical, chemical and microbiological stability
11. Mast-cell stability activity	Percentage of intact and disrupted mast cells
12. Antibacterial activity	Agar diffusion /well diffusion method
13. MIC	Minimum inhibitory concentration

These evaluations are important to establish the quality, stability and acceptability of the developed polyherbal syrup.^[1,13]

11. BIOLOGICAL EVALUATION OF THE FORMULATION

11.1 Antihistaminic/mast-cell stabilizing evaluation

The final formulation may be evaluated using an appropriate mast-cell stabilization model under institutional ethical approval.^[1]

The response may be assessed by determining the percentage of intact and disrupted mast cells after treatment. (1) Comparison may be made between.

- Control group
 - Sensitized group
 - Standard drug group
- Formulation treatment groups.

11.2 Antibacterial evaluation

The antibacterial activity of the formulation can be investigated using suitable bacterial strains and validated microbiological methods.^[3,8,9]

Agar diffusion/well diffusion can be used for preliminary screening, while MIC determination can provide quantitative information regarding antibacterial activity.^[3,8,9]

12. RESEARCH GAP

Although both plants have individually been investigated, limited information is available regarding their specific combination as a polyherbal syrup.^[1,13]

Important research gaps include

- Few studies have specifically investigated the exact of *C. reflexa*–*T. cordifolia* combination.
- The optimum ratio of the two extracts has not been clearly established.
- Limited information is available on standardization of the combined formulation.
- Limited mechanistic evidence is available regarding the potential mast-cell stabilizing activity of *C. reflexa*.
- Antibacterial activity of *T. cordifolia* may vary depending on extraction conditions, requiring further systematic evaluation.
- Limited safety information is available for the combined formulation.
- Stability studies are required to establish the physical, chemical, and microbiological stability of the formulation. “The proposed formulation may require further in -vivo validation to establish its biological activity and safety.”^[1,13]

13. FUTURE PERSPECTIVES

Future research may focus on.

- Isolation and identification of active phytoconstituents.

- Standardization using suitable analytical techniques. Optimization of the extract ratio.
- Investigation of possible synergistic or combined antibacterial activity.
- Detailed study of mast-cell stabilization mechanisms.
- MIC and MBC determination.
- Acute and repeated-dose toxicity studies.
- Stability testing under different storage conditions. Advanced preclinical investigations.

Clinical evaluation after establishing safety and efficacy.

14. CONCLUSION

Cuscuta reflexa and *Tinospora cordifolia* are medicinal plants containing diverse bioactive phytoconstituents and with reported phytochemical and pharmacological potential. Experimental evidence supports the mast-cell stabilizing activity of ethanolic *C. reflexa* extract, while several studies have demonstrated antibacterial activity of *T. cordifolia* extracts against different bacterial organisms.^[1,13]

“The reported activities of the two plants provide a basis for investigating their combination in a polyherbal syrup.” *C. reflexa* may be explored primarily for mast-cell stabilizing/antihistaminic relevance, whereas *T. cordifolia* may contribute antibacterial activity. “Nevertheless, the final formulation requires systematic optimization, standardization, quality evaluation, safety assessment and experimental validation. The available evidence provides a scientific basis for further investigation of the combination. Further experimental studies are required to establish the efficacy, safety and formulation suitability of the proposed polyherbal syrup.”^[1,13]

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