

Formulation and Evaluation of Microspheres of *Tinospora cordifolia*

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Received: 31st Oct 2024; Revised: 15th Nov, 2024; Accepted: 29th Nov, 2024; Available Online: 25th Dec, 2024

ABSTRACT

With so many medicinal benefits, *Tinospora cordifolia* is among the most adaptable revitalizing plants. In the present research work, microspheres of *Tinospora cordifolia* ethanolic extract were formulated by using emulsion solvent diffusion method. Evaluation parameters of the prepared formulation like powder density viz. bulk and tapped density, Hausner's ratio, percent compressibility and flow properties were checked. Phytochemical evaluation indicated presence of glycosides, alkaloids, tannins, phenols, starch, and sterols in the plant. The purpose of the current investigation was to check the antibacterial efficacy of *T.cordifolia* microspheres made. The same was achieved by using recommended microbiological strains viz. *Bacillus subtilis* and *Staphylococcus aureus*. The prepared formulation exhibited potent antibacterial activity against both bacterial strains.

Keywords: *Tinospora cordifolia*, Microspheres, Antimicrobial activity, Herbal extract
International Journal of Drug Delivery Technology (2024); doi: 10.25258/ijddt.14.4.X

How to cite this article: Mehta PP, Waghmode AD. Formulation and Evaluation of Microspheres of *Tinospora Cordifolia*. International Journal of Drug Delivery Technology. 2024;14(4):2205-08. doi: 10.25258/ijddt.14.4.35

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

Nowadays, formulations prepared from the natural sources like herbs play an important role in healthcare. Herbal formulations have also become a part of novel drug delivery systems (NDDSs), as they possess various advantages like enhanced drug solubility, dissolution rate, improved bioavailability etc. Even the problems of stability and poor absorption related to most of the herbal drugs can be overcome by NDDS, which leads to opening newer path towards the development of herbal drug delivery systems.¹⁻⁴ Microspheres are an important part of NDDSs and are capable to deliver a drug in a controlled way.⁵⁻⁷ *Tinospora cordifolia* (Fig.1) is among the extensively used herbs in Ayurvedic formulations. It belongs to family Menispermaceae. It is commonly known as Guduchi. Due to its various health benefits this medicinal herb has been used in the Indian system of medicine for the treatment of various disorders like dyspepsia, dysentery, urinary diseases, gonorrhoea, viral hepatitis, anaemia, general weakness and fever. Recently *T.cordifolia* was evaluated for the immunomodulatory properties, hypoglycemic activity, antioxidant activity, antipyretic, antineoplastic activity, hepatoprotective activity, diuretic, anti-tuberculosic activity, antistress, antidiabetic and antihyperglycemic activity.⁸⁻¹¹ To present, there are no published findings available on the antibacterial characteristics of its dosage form i.e., *T. cordifolia* microspheres. The objectives of the present investigation were to prepare microspheres of *Tinospora cordifolia* using Eudragit S100 by emulsion solvent diffusion method and to evaluate the same for *in vitro* properties and antibacterial activity. The role of *T. cordifolia* as a strong antibacterial herb has been examined and determined in the present research.

MATERIALS AND METHODS

Collection and authentication of plant material

Tinospora cordifolia whole plant was collected from Nira, Maharashtra during February to March 2024. The plant was authenticated as *T. cordifolia* by the Botanical Survey of India (BSI) which is located at Koregaon road; Pune and the voucher specimen were kept at the department of botany.

Extraction process

T.cordifolia stems were washed and then shed dried for 7 days. The dried stems were then grinded into fine powder. Dried stem powder (20 g) was taken in a thimble holder. Solvent ethanol (300 ml) was filled in the flask. In order to prevent sample particles from being transferred to the distillation flask, the thimble was clogged with cotton. In a Soxhlet system, the medication was extracted using ethanol for three hours (Fig.2). The ethanolic extract was obtained by filtering and concentrating the extract at room temperature.¹²

Preparation of microspheres

Emulsion solvent diffusion method was used to prepare floating microspheres (Fig.3). The ethanolic extract of *T. cordifolia* (250mg) and blends of polymers i.e. Eudragit (750mg), HPMC (250mg) and Ethylcellulose (250mg) were dissolved in ethanol/dichloromethane (1:1) mixture. In a beaker containing 0.2% sodium lauryl sulfate (SLS,) the resulting mixture was introduced and stirred for about 1 h at room temperature using a mechanical stirrer. The floating microspheres were then filtered, washed and dried overnight in an oven at 45°C (Fig. 3).¹³

Evaluation of Microspheres

Particle size

Conventional optical microscopy, the most commonly used procedure to visualize microparticles, was used to

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check the particle size of prepared microspheres. Using a calibrated eye piece micrometer, diameter of at least 10 particles was measured.

Drug entrapment efficiency

An accurately weighed powder of microspheres was added to 100 ml of distilled water. The solution was then filtered and drug content was determined by using UV spectrophotometer.¹⁴

Tapped density

By dividing a powder's mass by its tapped volume, one can determine the tapped density. A 10 ml graduated cylinder was carefully filled with the microsphere sample. The cylinder was tapped 100 times from a height of one inch onto a surface at intervals of two seconds.¹⁵

Bulk density

Sample of microspheres of known weight was poured into a

measuring cylinder and without tapping its length was measured. Bulk density was obtained by dividing the weight of formulation by the volume.¹⁶

Hausner ratio

Flowability of microparticles was determined by taking the ratio of tap and bulk density.¹⁷

Carr's index

Compressibility of a powder which is based on true density and bulk density was determined by calculating Carr's index.¹⁸

Angle of repose

To infer flowability of microparticles, angle of repose which is an indication of the frictional forces excited between granule particles was determined.¹⁹

Antimicrobial actions

The Agar well diffusion method is a popular technique for assessing a plant's or microbial extract's antibacterial activity. Microbial inoculum was spread over the agar plate surface for inoculation. Cork borer was used to make the wells in petri plates. Solution of a formulation was then added in a well. Two microbial strains viz. *Staphylococcus aureus*, *Bacillus subtilis* were used to assess the antimicrobial activity of *T. cordifolia* plant extract. Formulation inhibited the bacterial growth around the well.

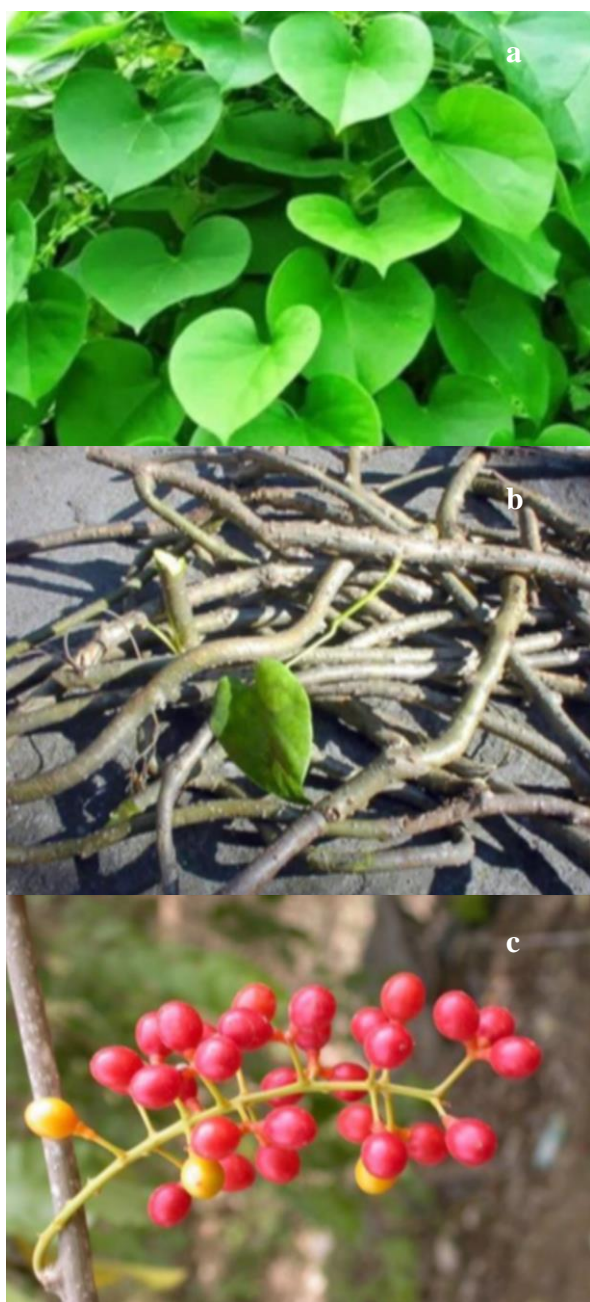


Figure 1: Parts of *Tinospora cordifolia* (a) leaves (b) stem (c) fruits.



Figure 2: Soxhlet Extraction.

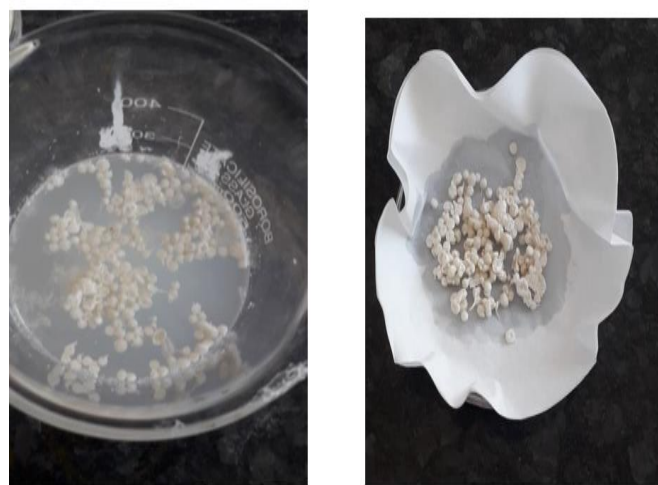


Figure 3: Microspheres of *Tinospora cordifolia*.



Control Plate

Zone of inhibition of *S. aureus*Zone of inhibition of *B. subtilis*Figure 4: Antibacterial activity of *T. cordifolia* microspheres.

The inhibited zone around the well was measured and recorded.²⁰

RESULT AND DISCUSSION

Phytochemical evaluation

Phytochemical analysis of *T. cordifolia* revealed the presence of phytochemicals like glycosides, alkaloids, tannins, phenols and starch.

Evaluation

Various parameters of prepared formulation were evaluated and the results of the same are exhibited in the table 1.

Particle size

Microspheres size ranges from 10-1000 micron. The size of formulated microspheres was found to be 876 micron which is in the range.

Drug entrapment efficiency

The drug entrapped into the microsphere was found to be 74.3 %.

Tapped density

Tapped density was calculated by using the standard formula and it was found to be 0.15gm/ml.

Bulk density

Bulk density of the microspheres was determined by using the standard formula and it was found to be 0.13gm/ml.

Hausner ratio

Hausner ratio of the formulated microspheres was found to be 1.134. The Hausner ratio value of formulated microspheres lies in between 1.12-1.18 which shows the good flow property.

Carr's index

The Compressibility index of formulated microspheres was found to be 13.33%. The value of Carr's index of formulated microspheres lies in between 11.0-15.0 which indicates good flow property.

Angle of repose

The value of angle of repose formulated microspheres lies in between 25–30 ° which indicates the good flow property of microspheres.

Antibacterial activity

Microspheres of *Tinospora cordifolia* showed good antibacterial activity against the bacterial strains of *B. subtilis* and *S.aureus* (Fig.4). The prepared formulation showed more antibacterial activity against *B.subtilis*

Table 1: Evaluation parameters and observations.

Sr.No	Evaluation Parameter	Observation
1.	Particle size	876 μ
2.	Drug entrapment efficiency	74.3%
3.	Tapped Density	0.15gm/ml
4.	Bulk Density	0.13gm/ml
5.	Hausner Ratio	1.134
6.	Carr's index	13.33%
7.	Angle of repose	29.05°
8.	Zone of inhibition	<i>S. aureus</i> – 1.2 cm <i>B. subtilis</i> -1.7cm

(1.7cm) than *S. aureus* (1.2cm).

CONCLUSION

Large numbers of medicinal plants have curative and antimicrobial activity against bacterial agents due to presence of bioactive constituents. *Tinospora cordifolia* has a potent antimicrobial activity to the presence of bioactive components such as glycosides, alkaloids, tannins, phenols, starch, and sterols etc. In the present work, microspheres containing *Tinospora cordifolia* extract were successfully formulated and evaluated. The prepared formulation showed potent antibacterial activity against the bacterial strains of *B.subtilis* and *S.aureus*.

Acknowledgements

The authors are thankful to the head of the institution & management of Navsahyadri Institute of Pharmacy, Pune for all the necessary facilities provided to carry out this research work.

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