IJPSR (2026), Volume 17, Issue 5 **(Research Article)**

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 27 December 2025; received in revised form, 17 March 2026; accepted, 07 April 2026; published 01 May 2026

TINOSPORA CORDIFOLIA FRUIT MUCILAGE EXTRACTION FOR ITS PHARMACEUTICAL APPLICATION

Noopur Verma and Ajay Kumar Gupta *

School of Pharmaceutical Sciences (Formerly University Institute of Pharmacy), CSJM University, Kanpur - 208024, Utter Pradesh, India.

Keywords:

Mucilage, *Tinospora cordifolia*, Fruit pulp, Traditional medicine, Pharmaceutical

Correspondence to Author:
Dr. Ajay Kumar Gupta

Associate Professor,
School of Pharmaceutical Sciences (Formerly University Institute of Pharmacy), CSJM University, Kanpur - 208024, Utter Pradesh, India.

E-mail: ajaykumargupta@csjmu.ac.in

ABSTRACT: Plant mucilages are increasingly explored in pharmaceutical research as sustainable alternatives to synthetic excipients. *Tinospora cordifolia* (Guduchi), a well-known medicinal plant in Indian traditional medicinal system, as it possesses diverse therapeutic properties including immunomodulatory, antioxidant, and anti-inflammatory effects. The stem and leaves of *Tinospora cordifolia* have been widely studied, but the fruit pulp mucilage remains relatively underutilized despite its promising pharmaceutical potential. Mucilage, a polysaccharide-rich material, exhibits swelling, viscosity, and gel-forming characteristics that make it suitable for applications such as binding, disintegration, stabilization, and controlled drug release. Extraction of mucilage from *Tinospora cordifolia* fruit pulp provides a cost-effective and biocompatible excipient source, aligning with the growing demand for natural and eco-friendly materials in drug formulation. Preliminary evaluation of physicochemical properties, yield, and functional performance is essential to establish its suitability for pharmaceutical use. Furthermore, cytotoxicity and biocompatibility studies are critical to ensure safety before clinical application. Overall, the exploration of *Tinospora cordifolia* fruit pulp mucilage offers significant potential in advancing natural polymer-based drug delivery systems, bridging traditional medicinal knowledge with modern pharmaceutical innovation.

INTRODUCTION: Mucilage derived from plant sources has gained increasing importance in pharmaceutical research due to its biocompatibility, biodegradability, and functional versatility. Mucilage extracted from medicinal plants has attracted attention as a promising excipient for drug delivery and formulation development. It is a natural, plant-derived polysaccharide that forms a viscous, gel-like substance when mixed with water [1]. It is obtained from various plant sources such as seeds, leaves, roots, and stems, and is widely used in pharmaceuticals, food industry, and biomedical fields due to its biocompatibility, biodegradability, and nontoxic nature.

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.17(5).1681-87

This article can be accessed online on www.ijpsr.com

DOI link: https://doi.org/10.13040/IJPSR.0975-8232.17(5).1681-87

Because of these properties, mucilage has gained considerable importance as a natural polymer in the development of modern drug delivery systems [2, 3]. *Tinospora cordifolia*, commonly known as Guduchi or Giloy, is an Indian traditional medicinal plant widely recognized in Ayurveda for its immunomodulatory, anti-inflammatory, and antioxidant properties. The stem and leaves have been extensively studied, but the fruit pulp mucilage remains relatively unexplored for pharmaceutical applications [4].

Fruit pulp mucilage is a polysaccharide-rich material that consists of complex carbohydrates containing sugars such as arabinose, xylose, galactose, rhamnose, and uronic acids, exhibiting desirable physicochemical properties such as swelling index, viscosity enhancement, and gel formation [5-7]. These characteristics make it suitable for use as a binder, disintegrant, stabilizer, and

controlled or sustained-release agent in drug formulations.

MATERIALS AND METHODS:

Extraction Procedure: Fruits of the *Tinospora cordifolia* plant were collected from a neem tree located in the health centre of the Indian Institute of Technology (IIT), Kanpur, Uttar Pradesh (India), in April–June. Authentication of plant material was carried out by Dr. K.M. Prabhukumar, Senior Scientist and Herbarium Curator, Plant Diversity, Systematics and Herbarium Division of CSIR-National Botanical Research Institute, Lucknow (PDSH/LWG/Authentication/Ang./2024-25/06) dated 08 April 2024. The fruits were thoroughly washed and shade-dried for subsequent experimental use.

Mucilage Extraction Procedure: The mucilage from the pulp of *Tinospora cordifolia* fruit was extracted using the method described by Chen *et al.* (2022), with slight modifications [8]. In brief, the fruit pulp (100 g) was soaked in 1 M NaOH solution at a ratio of 1:30 (w/v) for 6 hours at 50°C under continuous stirring. The resultant was filtered through a muslin cloth. The filtrate was neutralized to pH 6.84 with the help of distilled water, and the clear supernatant was concentrated using a rotary evaporator and subsequently precipitated with three volumes of acetone, and centrifuged. The precipitate was collected and lyophilized at -70°C for 36 h to obtain the crude mucilage product [9-12]. The percentage yield of mucilage was calculated using the following formula:

Yield (%) = Weight of dried mucilage / Weight of plant material used × 100

The formula sufficiently conveys the information; therefore, the accompanying explanatory sentence (% Yield = W1/ W2 ×100; Where W1 is weight of extracted polymer and W2 is weight of initial plant material) may kindly be removed to avoid redundancy.

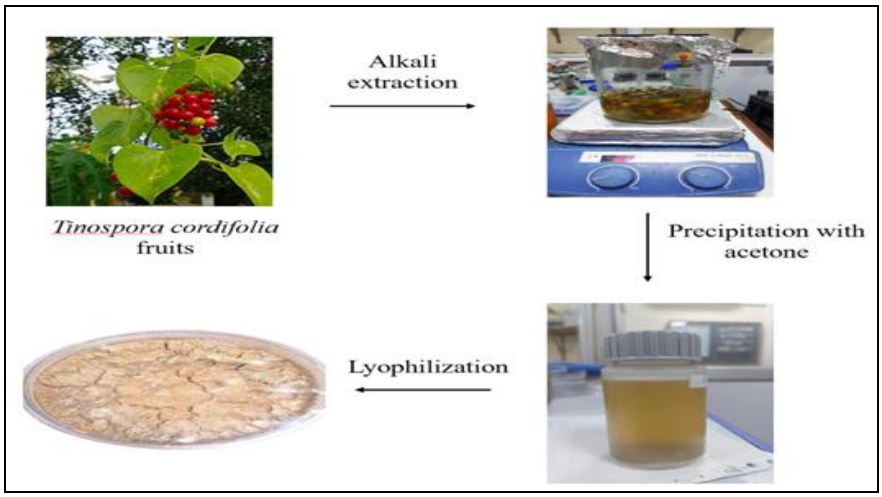

FIG. 1: MUCILAGE EXTRACTION PROCESS OF *TINOSPORA CORDIFOLIA* FRUIT PULP

Organoleptic Evaluation: The isolated fruit mucilage was subjected to organoleptic evaluation based on its morphological and sensory characteristics, including colour, odour, taste, fracture, and texture, as per the standard method [8, 9].

Phytochemical Evaluation: Preliminary identification tests, such as the Ruthenium red test, alcohol test, Molisch's test, and iodine test, were performed to confirm the mucilage's nature and assess its purity. In addition, phytochemical screening was carried out to determine the presence of various bioactive compounds. Alkaloids were identified using Mayer's and Dragendorff's tests, tannins by Braymer's test, proteins and amino acids by Ninhydrin and Biuret tests, phytosterols by the Libermann–Burchard test, flavonoids by the lead acetate test, reducing sugars by Benedict's and Fehling's tests, glycosides by the Keller–Killiani test, phenolic compounds by the ferric chloride test, and lignins by the Labat test. All evaluations were conducted following established protocols.

Physicochemical Characterization:

Determination of pH: The pH of the mucilage was determined using a digital pH meter (PH-300F). 1% (w/v) suspension of the isolated mucilage was

prepared in distilled water and filtered through a 0.45µm filter, and the pH values were determined [11].

Determination of Moisture Content (Loss on Drying): The moisture content of the mucilage was determined by calculating the percentage weight loss on drying. A known quantity (1 gm) of mucilage powder was weighed accurately and dried in a hot air oven at 105 °C for 3hr. The sample was cooled, reweighed and continued to dry for 30 min intervals until a constant weight was obtained. All measurements were performed in triplicate. The percentage moisture loss on drying was calculated from the following formula [10-12]:

% Loss on drying = (Initial weight - final weight) / (Initial weight) × 100

Solubility Study: The solubility of the extracted mucilage (10mg) was evaluated in various solvents (10ml) of different polarity, including distilled water, hot water, ethanol, methanol, acetone, chloroform, and ether [10, 13].

Determination of Swelling Index: The swelling index of the isolated mucilage was determined using a graduated cylinder method. One gram of mucilage powder was transferred into a 50 mL graduated measuring cylinder containing 25 mL of distilled water. The mixture was shaken thoroughly for 10 minutes at regular intervals for 1 hour to ensure proper hydration. The sample was then allowed to stand for 3 hours at room temperature. The final volume occupied by the swollen mucilage was recorded, and the swelling index was calculated from the following formula [10, 13]:

Swelling index = (Final weight of swollen sample-Initial weight of sample) / (Initial weight of sample) × 100

Determination of Bulk Density: Bulk density was determined to evaluate the packing behaviour of the mucilage powder. A known weight of mucilage powder was carefully introduced into a graduated measuring cylinder without compacting, and the volume occupied was recorded. Bulk density was calculated as the ratio of mass to bulk volume and expressed in g/cm³ [14, 17].

Bulk density (p) = (Powder weight (W) / (Bulk volume (Vb)

Determination of Tapped Density: Tapped density was measured using the standard tapping method. A known quantity of mucilage powder was placed in a graduated cylinder and subjected to mechanical tapping until a constant volume was obtained. The tapped density was calculated as the mass of the powder divided by the final tapped volume [14-17].

Tapped density (pt) = (Weight of powder (W) / (Tapped volume of powder (Vt)

Determination of Hausner's Ratio: Hausner's Ratio is the ratio of bulk density and tapped density values. The flowability of the mucilage powder was calculated using a formula [14-17]:

Hausner's ratio = (Tapped density) / (Bulk density)

Values close to 1 indicate good flow properties, while higher values indicate poor flowability.

Determination of Carr's Index: Carr's index is used to determine the compressibility of the mucilage powder. Values indicate reduced interparticle interactions, which in turn reflect improved flow properties of the mucilage powder and are calculated from the following formula [14-17]:

Carr's Index (%) = (Tapped density - Bulk density) / (Tapped density) × 100

Determination of Angle of Repose: The angle of repose was measured using the fixed funnel and free-standing cone method. The mucilage powder was allowed to flow through a funnel fixed at a certain height onto a flat surface to form a cone. The height and radius of the cone were measured, and the angle of repose was calculated using the formula [14, 17]:

Angle of repose, tan θ = height of cone (h) / radius of cone (r)

FTIR (Fourier Transform Infrared Spectroscopy): FTIR of isolated mucilage was conducted using a Perkin Elmer Spectrum instrument (Spectrum 2) in the spectral range of 4000- 400 cm^{-1}.

A measured amount of sample was finely ground with a mortar and pestle and mixed with potassium bromide (KBr) to form a pellet for the identification of functional groups related to polysaccharide structures. Peaks were analysed using Origin 2022b software [18-24].

SEM (Scanning Electron Microscopy): SEM of isolated mucilage was performed by mounting the dried mucilage sample onto a specially designed aluminium stub using double-sided adhesive tape. The mounted sample was then coated with a thin layer of gold using a sputter coater to enhance conductivity and magnified at 1000X. SEM imaging was carried out using a Carl Zeiss EVO 50 W-SEM instrument [19-25].

RESULTS AND DISCUSSION:

Isolation of Mucilage: The mucilage isolated from the fruit pulp of *Tinospora cordifolia* was evaluated for organoleptic, morphological, and physicochemical properties. The percentage yield of mucilage was found to be 7.96 ± 1.2% %, obtained by soaking the fruits in 1M NaOH (1:30 w/v) for 6 hr at 50 °C, followed by extraction, filtration, and drying of the mucilage.

Phytochemical Screening: Organoleptic evaluation of the isolated fruit mucilage revealed characteristic features consistent with polysaccharide-rich material showing brown colour with rough texture and mucilaginous touch, as shown in **Table 1.** Our findings are in accordance with Chen *et al* [9], and Vignesh *et al.* [11], who reported mucilage as greenish brown to creamy coloured mucilage powder. Preliminary identification tests confirmed the presence of mucilage and carbohydrates, as indicated by positive results in the Ruthenium red test and Molisch's test, [10, 11] as shown in **Table 2.**

TABLE 1: ORGANOLEPTIC EVALUATION OF ISOLATED MUCILAGE

S. no.	Parameter	Observation / Value
1	Colour	Light brownish
2	Odour	Odourless
3	Taste	Characteristic
4	Texture	Irregular and rough

TABLE 2: PRELIMINARY SCREENING OF ISOLATED MUCILAGE

S. no.	Phytoconstituent	Test / Reagent	Observation	Result
1	Mucilage	Ruthenium red test	Pink/red colouration	+
2	Carbohydrates	Molisch's test	Violet ring at the junction	+
3	Starch	Iodine test	No blue colour	-
4	Alkaloids	Mayer's test	No cream precipitate	-
5	Alkaloids	Dragendorff's test	No orange precipitate	-
6	Tannins	Braymer's test	No greenish colour	-
7	Proteins	Biuret test	No violet colour	-
8	Amino acids	Ninhydrin test	No purple colour	-
9	Phytosterols	Libermann–Burchard test	No green colour	-
10	Flavonoids	Lead acetate test	No yellow precipitate	-
11	Reducing sugars	Benedict's test	No brick red precipitate	-
12	Reducing sugars	Fehling's test	No red precipitate	-
13	Glycosides	Keller–Killiani test	No brown ring	-
14	Phenolic compounds	Ferric chloride test	No blue/green color	-
15	Lignin	Labat test	No red colouration	-

Physicochemical Analysis: The physicochemical characterization of the isolated mucilage material highlights its versetile pharmaceutical potential, as its pH value 6.84 ± 0.042, was close to neutrality, suggesting compatibility with a wide range of active pharmaceutical ingredients (APIs) and minimizing the risk of irritation upon administration. The moisture content (7.23 ± 1.02%) was relatively low, indicating reduced susceptibility to microbial contamination and improved shelf stability. The swelling index (14.74 ± 0.23) shows its significant hydration capacity and desirable candidate as a disintegrant, bioadhesive drug delivery system, or hydrophilic matrix for controlled release.

Flow properties were evaluated through bulk density (0.48 ± 0.01 g/cm³), tapped density (0.60 ± 0.01 g/cm³), Carr's Index (20.82 ± 2.1%), Hausner ratio (1.25 ± 0.01) and angle of repose (32.65 ± 0.23°). These values indicate fair flowability and are considered acceptable for formulation development [17, 18].

TABLE 3: PHYSICOCHEMICAL STUDY OF ISOLATED MUCILAGE

S. no.	Parameter	Observation / Value
1	pH	6.84 ± 0.042
2	Moisture content (%)	7.23 ± 1.02
3	Swelling index	14.74 ± 0.23
4	Bulk density (g/cm³)	0.48 ± 0.01
5	Tapped density (g/cm³)	0.60 ± 0.01
6	Carr's Index (%)	20.82 ± 2.1
7	Hausner ratio	1.25 ± 1.25
8	Angle of repose (°)	32.65 ± 0.23

Solubility Analysis: The isolated mucilage has maximum solubility in warm water rather than in organic solvents. This enhanced solubility may be due to the presence of hydroxyl groups in the polysaccharide structure, which facilitate hydrogen bonding with water molecules [23]. In contrast, the insolubility was observed in non-polar solvents as mentioned in **Table 3.**

TABLE 3: SOLUBILITY ANALYSIS OF ISOLATED POLYMER

S. no.	Solvent	Observation	Solubility
1	Cold water	Turbid solution	Slightly soluble
2	Warm water	soluble	Soluble
3	Ethanol	No visible change	Insoluble
4	Methanol	No visible change	Insoluble
5	Acetone	No visible change	Insoluble
6	Chloroform	No visible change	Insoluble
7	Ether	No visible change	Insoluble

FTIR (Fourier Transform Infrared Spectroscopy): The infrared spectrum displays several distinct absorption bands that reveal the functional groups present in the sample, as shown in **Table 4** and **Fig. 2.** An absorption peak at 3272 cm^{-1} indicates O–H stretching vibrations, suggesting the presence of a hydroxyl group of a sugar residue. A sharp, strong peak near 1623 cm^{-1} corresponds to stretching vibrations of carboxylate anions ($–COO^-$) and carbonyl groups (C=O) in compounds such as aldehydes, ketones, esters, or acids. Additional peaks around 2850–2950 cm^{-1} represent C–H stretching vibrations typical of alkanes. The fingerprint region between 600–1500 cm^{-1} shows multiple complex absorptions that provide unique structural information about C-O, C-C, and C-O-H bond vibrations of carbohydrates [23, 24].

TABLE 4: FTIR FREQUENCY AND FUNCTIONAL GROUP OF MUCILAGE

S. no.	Wave number (cm^{-1})	Functional Group
1	3272	Alcohol O–H stretching
2	2926	Alkyl C–H stretching
3	1623	C=O stretching
4	1545	N–H bending
5	1334	C–N stretching / O–H bending
6	1024	C–O stretching

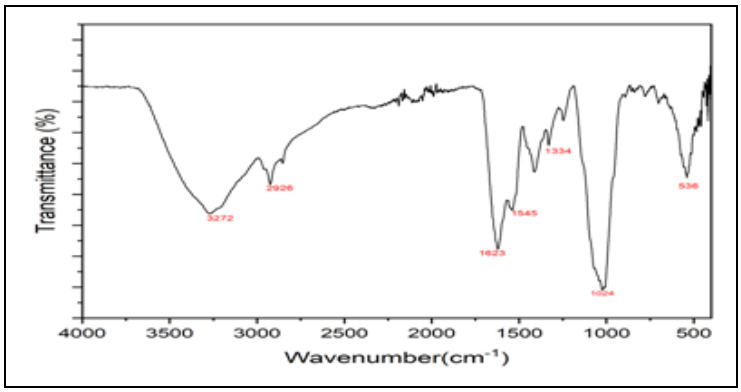

FIG. 2: FTIR OF ISOLATED MUCILAGE

SEM Analysis: The SEM micrograph of the dried sample exhibits a porous and heterogeneous surface morphology. The structure is defined by an interconnected network of folds, ridges, and voids, forming a loose, sponge-like matrix. The presence of irregular pores of varying sizes indicates high surface area and porosity. These morphological characteristics enhance water retention and contribute to the swelling capacity of the isolated mucilage, thereby improving its suitability for formulation development [24, 25].

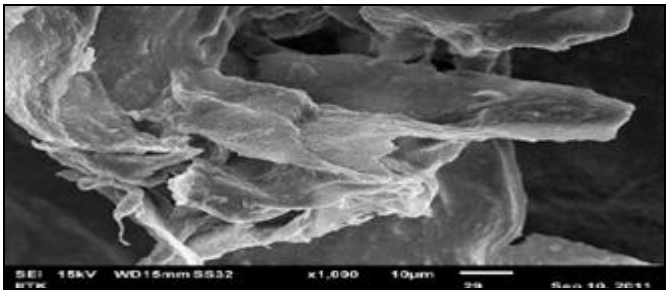

FIG. 3: SEM OF ISOLATED MUCILAGE

CONCLUSION: The mucilage extracted from the fruit pulp of *Tinospora cordifolia* was successfully isolated and assessed for its organoleptic, physicochemical, micromeritic, and structural features. The mucilage appeared light brown, odourless, and rough in texture, with a satisfactory yield, demonstrating the effectiveness of the extraction method. Its neutral pH, moderate moisture content, and high swelling index, along with the porous surface observed in SEM analysis, suggest its potential as a hydrophilic natural polymer for adaptable pharmaceutical uses. Micromeritic testing showed acceptable bulk and tapped densities with good flow properties, as indicated by Carr's index, Hausner ratio, and angle of repose, implying the powder is easy to handle and process. Phytochemical screening confirmed the of mucilage and carbohydrates, while other compounds were absent, indicating the purity of the isolated polymer. FTIR spectroscopy revealed characteristic peaks for hydroxyl, carbonyl, and ether groups, confirming its polysaccharide structure and supporting its role as a natural excipient. The results demonstrate that the mucilage has suitable physicochemical and structural properties and shows promise as a natural material for drug delivery systems.

ACKNOWLEDGEMENT: The authors gratefully acknowledge the institutional support and facilities provided by the administrators of Chhatrapati Shahu Ji Maharaj University, Kanpur, enabling the successful completion of this research. The authors also thank (Dr) Shreya and Harshita for their assistance during the study. Authors are particularly grateful to Prof. Vivek Verma, IIT Kanpur, for his consistent technical assistance and encouragement. The contributions acknowledged here were limited to general assistance and did not influence the study design, data interpretation, or manuscript preparation.

CONFLICTS OF INTEREST: The authors declare no conflicts of interest.

REFERENCES:

1. Alpizar-Reyes E, Carrillo-Navas H, Gallardo-Rivera R, Varela-Guerrero V, Alvarez-Ramirez J and Pérez-Alonso C: Functional properties and physicochemical characteristics of tamarind (*Tamarindus indica* L.) seed mucilage powder as a novel hydrocolloid. Journal of Food Engineering 2017; 1(209): 68-75. https://doi.org/10.1016/j.jfoodeng.2017.04.021
2. García AL, Zamora CP, Michaluk AG, Nuñez MB, González AM and Torres CA: Physicochemical and functional characterization of the mucilage obtained from cladodes of two *Opuntia* species. International Journal of Biological Macromolecules 2024; 1(283): 137802.https://doi.org/10.1016/j.ijbiomac.2024.137802
3. Gandhi KJ, Deshmane SV and Biyani KR: Polymers in pharmaceutical drug delivery system: a review. Int J Pharm Sci Rev Res 2012; 14(2): 57-66.
4. Sharma P, Dwivedee BP, Bisht D, Dash AK and Kumar D: The chemical constituents and diverse pharmacological importance of *Tinospora cordifolia*. Heliyon 2019; 5(9). https://doi.org/10.1016/j.heliyon.2019.e02437
5. Wasilewska K and Winnicka K: Ethylcellulose–a pharmaceutical excipient with multidirectional application in drug dosage forms development. Materials 2019; 17; 12(20): 3386.https://doi.org/10.3390/ma12203386
6. Hamid Akash MS, Rehman K and Chen S: Natural and synthetic polymers as drug carriers for delivery of therapeutic proteins. Polymer Reviews 2015; 55(3): 371-406.https://doi.org/10.1080/15583724.2014.995806
7. Kumar L and Verma R: *In-vitro* evaluation of topical gel prepared using natural polymer. International Journal of Drug Delivery 2010; 2(1): 58-63.
8. Sun XF, Wang HH, Jing ZX and Mohanathas R: Hemicellulose-based pH-sensitive and biodegradable hydrogel for controlled drug delivery. Carbohydrate Polymers 2013; 92(2): 1357-66.https://doi.org/10.1016/j.carbpol.2012.10.032
9. Chen S, Qin L, Xie L, Yu Q, Chen Y, Chen T, Lu H and Xie J: Physicochemical characterization, rheological and antioxidant properties of three alkali-extracted polysaccharides from mung bean skin. Food Hydrocolloids 2022; 1(132): 107867. https://doi.org/10.1016/j.foodhyd.2022.107867
10. Dubale S, Kebebe D, Zeynudin A, Abdissa N and Suleman S: Phytochemical screening and antimicrobial activity evaluation of selected medicinal plants in Ethiopia. Journal

of Experimental Pharmacology 2023; 31: 51-62. https://doi.org/10.2147/JEP.S379805

11. Vignesh RM and Nair BR: Extraction and characterisation of mucilage from the leaves of *Hibiscus rosa-sinensis* Linn. (Malvaceae). International Journal of Pharmaceutical Sciences and Research 2018; 9(7): 2883-90.
12. Harborne AJ: Phytochemical methods a guide to modern techniques of plant analysis. springer science and business media, first edition 199.
13. Hasanov I, Shanmugam S and Kikas T: Extraction and isolation of lignin from ash tree (*Fraxinus exselsior*) with protic ionic liquids (PILs). Chemosphere. 2022; (290): 133297. https://doi.org/10.1016/j.chemosphere.2021.133297
14. Moohan J, Stewart SA, Espinosa E, Rosal A, Rodríguez A, Larrañeta E, Donnelly RF and Domínguez-Robles J: Cellulose nanofibers and other biopolymers for biomedical applications. A review. Applied Sciences 2019; 10(1): 65.https://doi.org/10.3390/app10010065
15. Suman A and Singh V: An Inclusive Review on Mucilage: Extraction Methods, Characterization, and its Utilization for Nanocarriers Manufacturing. Journal of Drug Delivery & Therapeutics 2022; 12. https://doi.org/10.22270/jddt.v12i1-s.5210
16. Dybka-Stępień K, Otlewska A, Góźdź P and Piotrowska M: The renaissance of plant mucilage in health promotion and industrial applications: A review. Nutrients 2021; 13(10): 3354. https://doi.org/10.3390/nu13103354
17. Sunitha P, Sathyanarayana N, Sanker AU, Stanley F, Sobana R and Srilahari N: Isolation and Characterization of Mucilage obtained from *Abroma augustum* Leaf. International J of Research and Review 2020; 7(5): 54-8.
18. Oh S and Kim DY: Characterization, antioxidant activities, and functional properties of mucilage extracted from *Corchorus olitorius* L. Polymers 2022; 14(12): 2488.
19. Ahuja M, Kumar A, Yadav P and Singh K: *Mimosa pudica* seed mucilage: Isolation; characterization and evaluation as tablet disintegrant and binder. International Journal of Biological Macromolecules 2013; 57: 105-10. https://doi.org/10.1016/j.ijbiomac.2013.03.004
20. Monrroy M, García E, Ríos K and García JR: Extraction and physicochemical characterization of mucilage from *Opuntia cochenillifera* (L.) Miller. Journal of Chemistry 2017; 1: 4301901. https://doi.org/10.1155/2017/4301901
21. Roman Maldonado Y, Villanueva-Rodríguez SJ, Hernández-Hernández HM, Terrés E and Cervantes Martinez J: The correlation between the chemical composition and the microstructure of the polysaccharides of two varieties of Mexican red prickly pear fruits. Foods 2024; 13(23): 3914.https://doi.org/10.3390/foods13233914
22. de la Paz Salgado-Cruz M, Calderón-Domínguez G, Chanona-Pérez J, Farrera-Rebollo RR, Méndez-Méndez JV and Díaz-Ramírez M: Chia (*Salvia hispanica* L.) seed mucilage release characterisation. A microstructural and image analysis study. Industrial Crops and Products 2013; 1(51): 453-62. https://doi.org/10.1016/j.indcrop.2013.09.036
23. Capitani MI, Ixtaina VY, Nolasco SM and Tomás MC: Microstructure, chemical composition and mucilage exudation of chia (*Salvia hispanica* L.) nutlets from Argentina. Journal of the Science of Food and Agriculture 2013; 93(15): 3856-62.https://doi.org/10.1002/jsfa.6327
24. Shiehnezhad M, Zarringhalami S and Malekjani N: Optimization of microwave-assisted extraction of mucilage from *Ocimum basilicum* var. album (L.) seed. Journal of Food Processing and Preservation 2023; 1: 5524621.https://doi.org/10.1155/2023/5524621
25. Otálora MC, Wilches-Torres A, Lara CR, Cifuentes GR and Gómez Castaño JA: Use of *Opuntia ficus-indica* fruit peel as a novel source of mucilage with coagulant physicochemical/molecular characteristics. Polymers 2022; 14(18): 3832. https://doi.org/10.3390/polym14183832
26. Kurd F, Fathi M and Shekarchizadeh H: Basil seed mucilage as a new source for electrospinning: Production and physicochemical characterization. International Journal of Biological Macromolecules 2017; 1(95): 689-95. https://doi.org/10.1016/j.ijbiomac.2016.11.116
27. Mishra A, Clark JH and Pal S: Modification of Okra mucilage with acrylamide: Synthesis, characterization and swelling behavior. Carbohydrate Polymers 2008; 10; 72(4): 608-15. https://doi.org/10.1016/j.carbpol.2007.10.009

How to cite this article:
Verma N and Gupta AK: *Tinospora cardifolia* fruit mucilage extraction for its pharmaceutical application. Int J Pharm Sci & Res 2026; 17(5): 1681-87. doi: 10.13040/IJPSR.0975-8232.17(5).1681-87.