Investigation of the Anti-Inflammatory and Antimicrobial Activities of Garcinia cambogia Fruit Extracts: A Natural Approach to Diabetic Foot Ulcer Therapy

M. Maria Caroline Rebellow[1], G. Sriram Prasath[1]
Sivaranjani. S[1], Durga. B[2]
[1]Post graduate and Research Department of Biochemistry, Dwaraka Doss Goverdhan Doss Vaishnav College, Arumbakkam, Chennai-106, Tamilnadu. India
[2]Professor & Vice Principal, Department of Biochemistry, Meenakshi College of Allied Health Sciences, Meenakshi Academy of Higher Education & Research, Chennai -78, Tamilnadu. India

Corresponding author
Prof. M Maria Caroline Rebellow
Assistant Professor
PG and Research Department of Biochemistry
Dwaraka Doss Goverdhan Doss Vaishnav College
Arumbakkam, Chennai-106

Abstract

For over 5,000 years, medicinal herbs have been integral to traditional medical practices across various cultures worldwide. They represent one of the oldest forms of treatment, with knowledge about their healing properties passed down through generations. Natural plant materials remain a major source of pharmacologically active compounds, and many modern drugs used in pharmacotherapy have their origins in traditional herbal medicine. This study evaluated the anti-inflammatory and antibacterial activities of *Garcinia cambogia* ethanol fruit extracts. Anti-inflammatory potential was assessed using a protein denaturation assay, where the extract demonstrated concentration-dependent inhibition of albumin denaturation (50–1600 µg/ml), comparable to the standard drug diclofenac sodium. The extract's activity is likely attributed to xanthones, a key secondary metabolite. Antibacterial activity was tested against *Staphylococcus aureus* (Gram-positive) and *Escherichia coli* (Gram-negative), both commonly associated with diabetic foot ulcers (DFUs). While no inhibition was observed against *E. coli* at 2000 µg/ml, increased concentrations (4000 µg/ml) showed effectiveness. The extract exhibited notable antibacterial activity against *S. aureus*, supporting its traditional use and potential as a natural therapeutic agent for inflammation and DFU-related infections.

Keywords: *Garcinia cambogia; Antibacterial activity*; *Antiinflammatory potential* ; *Phytochemicals*

Introduction

India is richly endowed with natural resources, and traditional knowledge of medicine and plant-based remedies plays a vital role in the country's healthcare system. Today, herbalism has gained global recognition and has become a mainstream approach in many parts of the world. This growing acceptance is largely due to increased awareness of the value of traditional medical systems and the discovery that many medicinal plants—documented in indigenous pharmacopeias—possess significant therapeutic properties, either in their raw form or as precursors to modern pharmaceutical drugs. Recent research has explored the potential of traditional plant-based medicines in wound healing, especially in treating conditions like diabetic foot ulcers (DFUs), a common and serious complication in individuals with diabetes. DFUs are particularly difficult to heal due to poor blood circulation, nerve damage, and high blood sugar levels, making them susceptible to infections that can lead to amputations if not properly managed. The use of herbal medicine as a source for drug development is both promising and logical, but further detailed research is required. In particular, comprehensive in vitro studies and an understanding of the pharmacokinetics of these bioactive compounds are crucial. Such investigation will enhance the preclinical and clinical evaluation processes, paving the way for innovative therapeutic approaches to treat diabetic foot ulcers and potentially leading to the discovery of new, effective drugs.

Garcinia cambogia is also known as Garcinia gummi-gutta (L.) N. Robson, a botanical remedy utilized by Kerala traditional healers, was highlighted. Known by its Tamil name Kodumpuli and its English name Malabar Tamarind, it is a member of the Clusiaceae family. Along with the subtropical regions of Asia, such as China, Malaysia, and the Philippines, it is extensively dispersed throughout the Indian state of Kerala, especially in the Western Ghats, from the Konkan south to Travancore east [1] *Garcinia cambogia is found to possess anticancer* [2-3] antiobesity [4], antioxidant [5], anti –ulcer [6], anti-inflammatory [7] and cardioprotective properties [8] . Recently we have reported for the antioxidant, antidiabetic,

cytoprotective, and wound-healing effect of *Garcinia cambogia [9]*. In view of medicinal importance of *Garcinia cambogia*, the present study aims at investigating the anti-inflammatory and antibacterial effect its ethanolic extract against diabetic foot ulcer.

MATERIAL AND METHODS

Collection of plant material

The plant material of Garcinia cambogia used in this study was collected from a local market, in Madhuranthakam.

Preparation of extract

The fruits were given time to dry. Following that, these 250g fruits were shade dried for three to five days without any contamination. After being ground into powder using an electronic grinder, the fruits were kept at 5° C in an airtight container until they were needed. Using a Soxhlet device, ethanol was used to extract the powdered fruit for a whole day. nFollowing extraction, a Whatman No. 1 filter paper was used to filter the liquid. The rotary vacuum evaporator was used to concentrate the filtrate to dryness at 40°C with decreasing pressure, and the powder was then stored at room temperature.

Anti inflammatory Activity

Protein Denaturation Assay

The experiment was carried out with minor modification Priya *et al.* 2011. Different concentrations (50, 100, 200, 400, 800 and 1600 µg/mL) of test samples **(KAqEE)** and reference standard (Diclofenac sodium) and control (without standard/test sample) were made up to 4 mL of phosphate buffer solution (0.2 M, pH 7.4). 1 mL of 1mM albumin solution in phosphate buffer was mixed with all the tubes and incubated at 37 °C in incubator for 15 min. Denaturation was induced by keeping the reaction mixture at 60 °C in water bath for 15 min.

After cooling, the turbidity was measured at 660 nm. The percentage inhibition of denaturation was calculated by using following formula,

% Inhibition = [(OD of test - OD of control)/OD of test] x 100.

Antibacterial study of *Garcinia cambogia* fruit extract against DFU inducing pathogens.

The bacterial species used for the test were *Staphylococcus aureus* (*Gram Positive*), *Escherichia coli* (*E. coli – Gram negative*). All the stock cultures were obtained from Microbial Type Culture Collection and Gene Bank (MTCC), Chandigarh

Disc Diffusion Method

The antibacterial activity of the test sample was carried out by disc diffusion method. The targeted microorganisms were cultured in Mueller-Hinton broth and incubated for 24 h. The petri dishes containing Mueller Hinton agar (MHA) medium were cultured with diluted bacterial strain. The prepared discs were placed on the culture medium. Test samples (1000µg, 2000µg and 4000µg) were injected to the sterile disc. Then the inoculated plates were incubated at 37 °C for 24 h. The diameter of the clear zone around the disc was measured and expressed in millimetres as its antibacterial activity [10]

RESULTS AND DISCUSSION

Anti-inflammatory Activity

For the assessment of anti-inflammatory activity of the *Garcinia cambogia* fruit extracts, the protein denaturation assay was carried out. The present findings exhibited concentration dependent inhibition of albumin (protein) denaturation by *Garcinia cambogia* crude fruit ethanol extracts throughout the concentration range of 50 to 1600 µg/ml. Diclofenac sodium at the concentration range of 50 to 1600 µg/ml was used as reference drug

Plate 1: Protein Denaturation Assay of Standard Drug- Diclofenac sodium

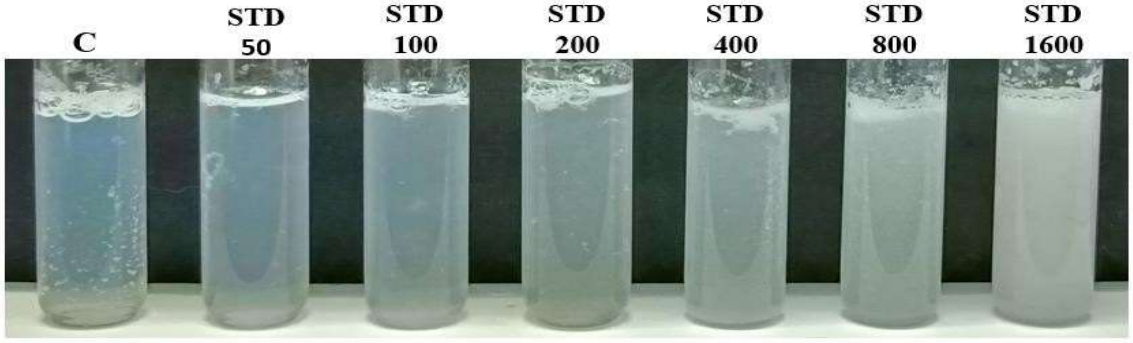

Plate 2: Protein Denaturation Assay of Ethanol Extract of *Garcinia cambogia* Fruit

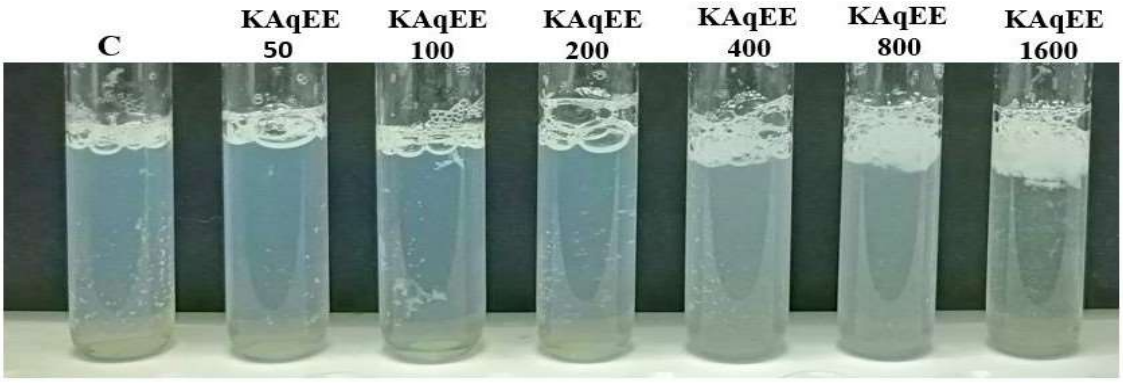

Table 1: Protein Denaturation Assay for Different Crude Extracts of *Garcinia Cambogia* Fruit

Conc. (µg/ml)	KAqEE	Diclofenac sodium
50	27.37±1.78	49.41±0.86
100	40.93±1.20	63.65±0.52
200	49.66±0.99	68.90±0.32
400	59.25±0.80	83.21±0.12

800	66.00±0.40	89.60±0.04
1600	70.83±0.34	92.98±0.01

Data are presented as mean ± SD values of triplicate determinations.

Table 2: IC 50 Value for Protein Denaturation Assay of Crude Ethanol Extracts of *Garcinia cambogia* Fruit

Sample	IC50 Value
KAqEE	234.58
Standard	41.23

Protein denaturation assay indicates the *Garcinia cambogia* ethanol extract has anti- inflammatory activity was showed in the image. The % of inhibition were identified based on the OD value, the IC50 values are calculated & represented in the table. Based on the value the ethanol has considerable anti-inflammatory activity as compared with standard. The current research is to explore the usage of *Garcinia cambogia* fruit against inflammation experimentally representing significant activity. Hence *Garcinia cambogia* fruit can be used as a potent natural anti-inflammatory agent. The anti-inflammatory activity might be due to xanthones present as one of the secondary metabolite.

Antibacterial activity of *Garcinia cambogia* extract against diabetic foot ulcer inducing pathogens.

This study was conducted to determine the antibacterial activity of extract against main pathogenic bacterial infections associated with DFU. The Antibacterial activity of the extracts was checked for its efficiency against two bacterial species, similarly to prove the extract activity against DFU inducing pathogens this test is carried out. Among pathogens one gram positive - *Staphylococcus aureus* and the gram negative - *Escherichia coli* bacteria were preferred to perform the test. Based on the preliminary antimicrobial result the extract concentration is increased to prove the activity. The obtained results are presented in Table 3. The results from the zone inhibition method, indicated that the *Garcinia Cambogia* ethanol extracts inhibits the pathogenicity effect of gram positive bacteria at 2000µg concentrations & also 4000µg concentration as compared with standard streptomycin (20µg).

Likewise, the extract was treated against gram negative bacteria, the zone of inhibition was detected. our result observed that no zone of inhibition was observed for Ethanol extract against E. coli at 2000 µg of the concentration as compared with standard streptomycin (20µg) but the it shows antibacterial activity as further increased in concentration (4000µg). The zone of inhibition of different concentration of extract of *Garcinia cambogia* were showed in the image. The results of the present study support the traditional use of *Garcinia cambogia* as an antibacterial agent. The various study reports also suggest the similar result ***[11]***

Table 3: Antimicrobial activity of *Garcinia cambogia* extract

Sample	Zone of Inhibition (mm)					
	Microorganisms					
	E.coli			*S.aureus*		
Extract	1000µg	2000µg	4000µg	1000µg	2000µg	4000µg
	-	-	10	-	10	12
Streptomycin (20µg/ml)	20			22		

Percentage of Zone of Inhibition values are expressed as mm. The obtained data are compared with streptomycin as standard.

Control Gram positive Bacteria Gram negative Bacteria

Plate 3: Anti-bacterial Activity of *Garcinia cambogia* Fruit extract against DFU inducing Pathogen

Conclusion

The study demonstrated that *Garcinia cambogia* ethanol fruit extract exhibits significant anti-inflammatory activity, as shown by its concentration-dependent inhibition of protein denaturation. The extract also showed promising antibacterial activity, particularly against *Staphylococcus aureus* at higher concentrations. While no activity was initially observed against *E. coli*, increased extract concentrations yielded inhibitory effects. These results support the traditional use of *Garcinia cambogia* as both an anti-inflammatory and antibacterial agent. Further studies are warranted to isolate active compounds and validate its therapeutic potential against diabetic foot ulcer pathogens.

Acknowledgement

The authors wish to thank the management of Dwaraka Doss Goverdhan Doss Vaishnav College, Chennai for having sanctioned the project proposal (Lr No: DDGD/IQAC/RDC PROJECT/2024-2025/DE3/SCIENCES 13 dated 5th October 2024) and provided the seed money for the project.

REFERENCES

1. Chuah, L. O., Ho, W. Y., Beh, B. K., & Yeap, S. K. (2013). Updates on antiobesity effect of Garcinia origin (−)-HCA. Evidence-Based Complementary and Alternative Medicine, 2013(1), 751658.
2. Rasha, H. M., Salha, A., Thanai, A., & Zahar, A. (2015). The biological importance of Garcinia cambogia: a review.
3. Sambavathas, S., Amarasinghe, N. R., Jayasinghe, L., & Fujimoto, Y. (2022). 7 Acetylcholinesterase inhibitory activity of spices and culinary herbs. *Chemistry of Natural Products: Phytochemistry and Pharmacognosy of Medicinal Plants*, 139.
4. Uauy, R., & Díaz, E. (2005). Consequences of food energy excess and positive energy balance. *Public health nutrition*, *8*(7a), 1077-1099.
5. Sharma, A., Joseph, G. S., & Singh, R. P. (2014). Antioxidant and antiplatlet

aggregation properties of bark extracts of Garcinia pedunculata and Garcinia cowa. *Journal of food science and technology*, *51*, 1626-1631.

6. Mahendran P, Vanisree AJ, Shyamala Devi CS (20020. The antiulcer activity of Garcinia cambogia extract against indomethacin-induced gastric ulcer in rats. Phytother Res. 2002 Feb;16(1):80-3.
7. Ali, N., Khan, S., & Raza, S. (2015). Evaluation of the anti-inflammatory potential of Garcinia cambogia in experimental models. Journal of Medicinal Plants.
8. Soni, M. G., White, S. M., & Hodge, A. (2016). Cardiovascular effects of *Garcinia cambogia* in humans: A review of the literature. *Journal of Clinical and Experimental Cardiology*, 7(2), 102-109.
9. M. Maria Caroline Rebellow, Sivaranjani. S, Durga. B, Therapeutic Potential of *Garcinia cambogia* Ethanolic Extract in the Management of Diabetic Foot Ulcers: A Phytochemical and Pharmacological Evaluation, YMER, VOLUME 24 : ISSUE 08 (Aug) – 2025,522-535
10. EK Elumalai, M Ramachandran, T Thirumalai, P Vinothkumar. Antibacterial activity of various leaf extracts of MerremiaemarginataAsian Pac J of Trop Biomed. 2011; 1(5): 406-408.
11. Armstrong D, Boulton M, Bus S. Diabetic foot ulcers and their recurrence. N Engl J Med (2017) 376(24):2367–75. doi: 10.1056/NEJMra1615439