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GOLD NANOPARTICLES FROM BROWN ALGAE OF TURBINARIA SPECIES AND THEIR ANTI- INFLAMMATORY ACTIVITY

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ABSTRACT

Introduction

Inflammation is a complex biological response that plays a crucial role in the body's defense mechanism. However, dysregulated inflammation can contribute to the development of various chronic diseases, such as cardiovascular diseases, cancer, and autoimmune disorders. Brown algae are common marine creatures along the shore that are recognised for having a wealth of bioactive chemicals. Due to their numerous pharmacological characteristics, which include anti-inflammatory actions.

Aim

To study the Gold nanoparticles from brown algae of Turbinaria sp. and their anti-inflammatory potential

Materials and methods

Preparation of crude extract from *Turbinaria* species, synthesis of gold nanoparticles from aqueous extract of seaweed, protein denaturation assay was conducted to evaluate the anti- inflammatory activity

Results

Protein denaturation assay was done on the gold nanoparticles from brown algae. It was found that the gold nanoparticles when compared to the standard diclofenac showed high anti- inflammatory activity. It was observed that the anti- inflammatory activity of the extract increased as the concentration increased.

Discussion

The results indicated that the marked attenuation of protein denaturation in a concentration dependent manner with maximum action of 47% at 100µg/ml. total flavonoid contents and the aqueous fraction of *Turbinaria* sp. exhibited marked attenuation of thermal-induced protein denaturation. Of the tested species, total flavonoid contents of the species were most dominant in the inhibition of protein denaturation.

Conclusion

In conclusion, the synthesis of AuNPs from brown algae of *Turbinaria* sp. demonstrates their anti-inflammatory potential. These nanoparticles hold promise for the development of novel therapeutic strategies for inflammation-related disorders.

Keywords: Brown algae, Inflammation, Protein denaturation assay, Gold nanoparticles, Diclofenac

INTRODUCTION

Turbinaria species, a diverse genus of brown algae found abundantly in marine environments, have recently garnered attention in the field of dentistry for their potential applications. These algae offer a promising array of bioactive compounds, which can be harnessed to enhance oral health and revolutionize various aspects of dentistry. The natural bioactive compounds found in *Turbinaria* species, including polyphenols, flavonoids, and polysaccharides, an example being laminarin in brown seaweeds are storage poly- saccharides. Similar to that, it has a high content of biologically active substances, such as polyphenols, protein, fiber, carotenoids, vitamins, and minerals.(1)Brown algae, which contains tannins, saponins, phenols, and other compounds, is one of the natural remedies that can be used to treat periodontal diseases including gingivitis and periodontitis. In order to guard against implant contamination and infection after surgery, alginates made from marine brown algae were applied to the implant surfaces. This is because these marine products exhibit bacteriostasis in their natural form.(2) A greater number of individuals are choosing cosmetics made from seaweed than from synthetic materials because they don't contain any dangerous chemicals. In addition to being essential humectants and moisturizers in cosmetic formulations, polysaccharides obtained from seaweeds can also be employed as thickeners, gelling agents, film formers, and emulsifiers.(3)

These attributes have sparked considerable interest in their potential to combat oral infections, reduce inflammation, and neutralize harmful free radicals that can damage oral tissues. Incorporating these bioactive compounds into dental products could lead to innovative solutions for gum disease, oral infections, and overall oral health maintenance.

Small substances with at least one dimension smaller than 100 nm are known as nanomaterials. They work well as catalysts and adsorbents because of their tiny size and large reactive surfaces. (4)One of the oldest materials used in dentistry is allegedly gold. The qualities of gold are enhanced when it is reduced to nanoparticles. This is so that any biomolecules it comes into contact with can move more easily, as gold nanoparticles (AuNP) are reported to have a high surface plasmon resonance and surface ratio. AuNP can be produced using biological processes that are environmentally benign. (5)

Gold nanoparticles have emerged as a fascinating and highly versatile class of nanomaterials that have captured the attention of scientists, engineers, and researchers across various fields. Their unique properties and potential applications have made them a prominent player in nanotechnology, with a wide range of uses in medicine, electronics, catalysis, environmental remediation, and more. (6) AuNPs can be synthesized with precise control over their size, shape, and surface properties, allowing for tailor-made nanoparticles with specific functionalities. One of the most significant advantages of AuNPs is their excellent biocompatibility, which has led to numerous biomedical applications. In medicine, AuNPs have shown immense promise in drug delivery, cancer therapy, imaging, and diagnostics. (7)

Although AuNPs are generally considered biocompatible, their long-term effects and potential toxicity need thorough investigation, especially when applied in medical or dental settings. Achieving consistent nanoparticle size, shape, and stability for reproducibility and reliable therapeutic outcomes. The aim of the study is to analyze the anti- inflammatory activity of gold nanoparticles from brown algae of *Turbinaria* species.

MATERIALS AND METHODS

This study was conducted in the blue lab of Saveetha dental college and hospitals for a duration of 3 months. The plant was first obtained and used to create the crude extract followed by the synthesis of gold nanoparticles.

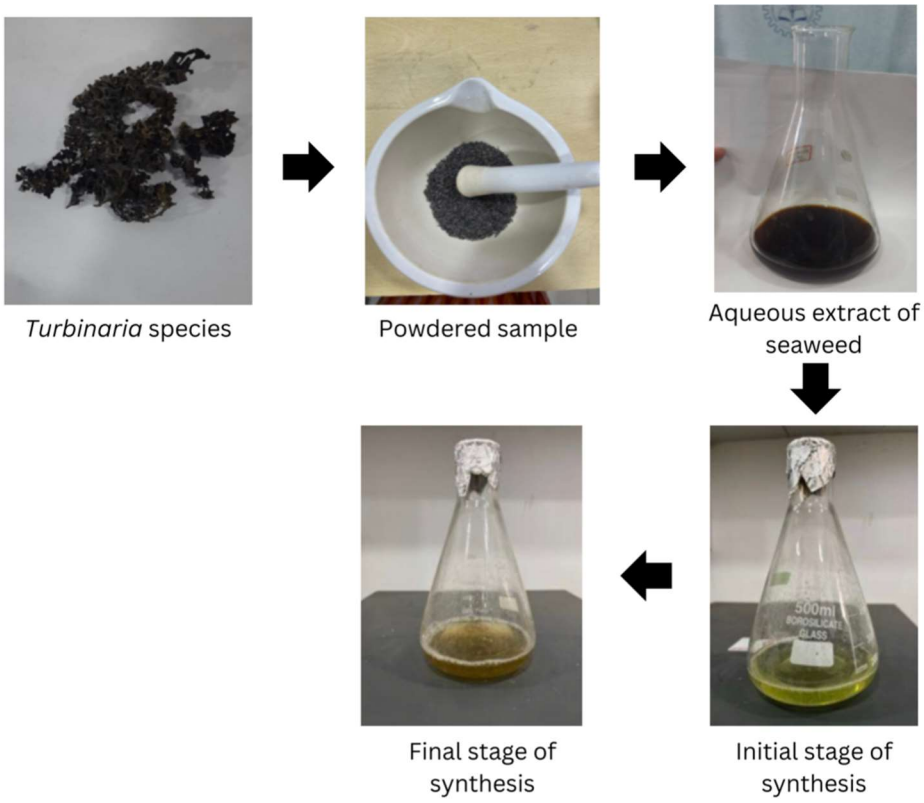
Preparation of the crude extract from *Turbinaria* species:-

10g of the powdered sample was added into 200 ml of 20% ethanol. The sample in the flask was kept in the orbital shaker for 2 days, after that the samples were filtered through wattman's filter paper 1. The filtered sample was further transferred into a 100 ml beaker and was kept in the water bath at 60°C until it became cool.

Synthesis of gold nanoparticles from aqueous extract of seaweed:-

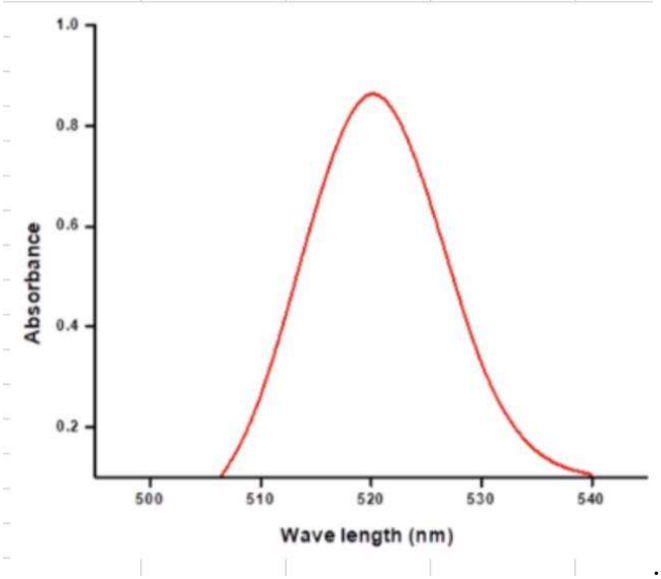
60 ml of gold chloride solution was taken in a conical flask, of which 5 ml was added to 10 ml of *Turbinaria* seaweed aqueous extract. The initial reading is observed at 500-600 nm using a UV spectrophotometer. The flask is then well kept in the orbital shaker until the color changes. Once the Color change is observed the final reading of the gold nanoparticles was taken.

The nanoparticle sample was further centrifuged at 5000 rpm for 15 minutes, the pellets were then collected and dried in the hot air oven at 60°C. The crude extract was used in the anti- inflammatory assay



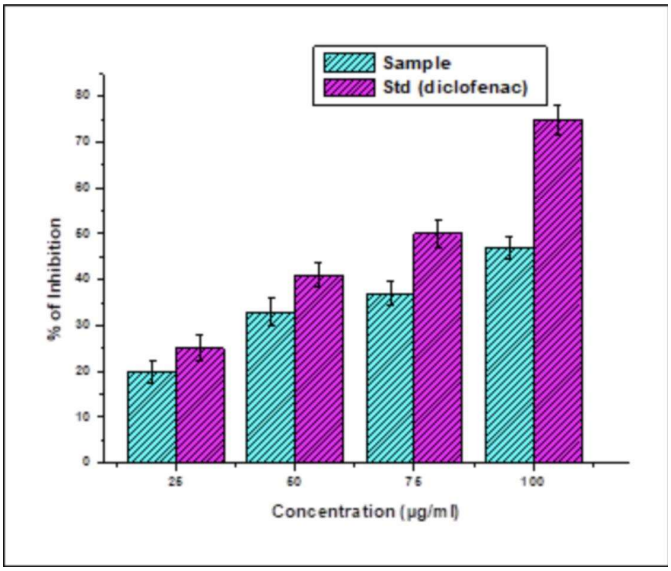
RESULTS

The study was conducted to evaluate the anti- inflammatory properties of the gold nanoparticles from brown algae of *Turbinaria* species. The results of the conducted study were as follows.



Graph 1:- UV spectroscopy

From the above graph we can observe that the absorbance of the gold nanoparticles is highest at a wavelength of 520 nm. Initially, as the wavelength increases the absorbance of the gold nanoparticles also increases but after the highest point, that is at 520 nm, the absorbance decreases.



Graph 2:- Protein Denaturation assay

Protein denaturation assay was conducted to analyze the anti- inflammatory activity of gold nanoparticles from brown algae of *Turbinaria* species. From the above table we can observe that the results obtained were compared with the standard diclofenac. As the concentration increases the percentage of inhibition also increases. The highest being observed at 100 microgram/ ml approximately being at 45%.

DISCUSSION

The in vitro anti-inflammatory properties of the AuNPs utilizing P. serrulata fresh fruit extract were investigated. The findings imply that P. serrulata fresh fruit extract is an environmentally favorable source for the environmentally friendly synthesis of P-AgNPs and P-AuNPs, which can also be used as a novel therapeutic agent for the prevention and treatment of inflammation due to their biocompatible nature. (8) Similarly, when gold nanoparticles were obtained from brown algae of *Turbinaria* species it was found to have potent anti- inflammatory activity, making it a good agent in the prevention and treatment in cases related to inflammation.

The current study looked into how three different seaweeds' macroalgal extracts may be used to biosynthesize environmentally acceptable Au-NPs. The generated Au-NPs showed a significant inhibitory effect on protein denaturation. The results indicated the anti-inflammatory activity of the seaweed's macroalgae extract increased as the concentration increased. (9)Similarly, in this study the gold nanoparticles from brown algae showed significant anti- inflammatory activity on protein denaturation assay. Just like the mentioned results the studies results were found to have similar findings, the anti inflammatory activity of the gold nanoparticles increased as the concentration increased.

Carrageenan-induced paw edema in rats and a vascular permeability assay in mice, the anti-inflammatory efficacy of *Turbinaria* ornata aqueous extract was assessed in a previous study. The T. ornata aqueous extract's in vivo anti-inflammatory activity showed a significant (P 0.05) dose-dependent defense in both the carrageenan-induced paw edema and the vascular permeability test. The current study suggests that ATO's putative antioxidant and free radical scavenging properties may be responsible for its anti-inflammatory action. (10) In this study the anti- inflammatory activity of the brown algae was assessed using protein denaturation assay, it was found that the species showed potent action against inflammation due to the bioactive compounds available in the *Turbinaria* species such as polyphenols and polysaccharides.

In a prior work, Turbinochromanone—an unidentified furanyl-substituted isochromanyl metabolite—was fractionated from the crude extract of *Turbinaria* conoides. It was discovered to exhibit possible attenuation capabilities against the inflammatory enzymes 5-lipoxygenase and cyclooxygenase-2. When compared to diclofenac, turbinochromanone was found to have a higher index of anti-inflammatory activity.(11) Similar to this, it was shown in the conducted study that although the extract's anti-inflammatory action wasn't as strong as that of standard diclofenac at higher doses, it was found to be quite strong at lower quantities.

CONCLUSION

From the above conducted study we can conclude that the gold nanoparticles synthesized from the brown algae showed potential anti- inflammatory activity. This property was observed due to the natural bioactive compounds found in the *Turbinaria* species by regulating immune responses and lowering the production of inflammatory mediators like cytokines and prostaglandins. Further

investigations can be done on how it can be applied in dental and biomedical sciences in the management of inflammatory conditions.

CONFLICT OF INTEREST

There is no conflict of interest

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ETHICAL CLEARANCE

Since this is an in vitro study, ethical clearance is not required.

REFERENCES

1. Bhakuni DS, Rawat DS. Bioactive Marine Natural Products. Springer Science & Business Media; 2006. 382 p.

2. Michalak I. Marine Biologically Active Compounds as Feed Additives. MDPI; 2020. 140 p.

3. Aavula T, Narasimman V, Ramachandran S, Murugan R, Ponnusamy M, Pazhani GP, et al. Antioxidant and Teratogenic Activities of Formulated Agar Extracted from Brown Seaweed against Zebrafish Larvae. Evid Based Complement Alternat Med. 2022 Jul 11;2022:3520336.

4. Thangavelu L, Veeraragavan GR, Mallineni SK, Devaraj E, Parameswari RP, Syed NH, et al. Role of Nanoparticles in Environmental Remediation: An Insight into Heavy Metal Pollution from Dentistry. Bioinorg Chem Appl. 2022 Mar 17;2022:1946724.

5. Chaughule RS. Dental Applications of Nanotechnology. Springer; 2018. 277 p.

6. Sakthi Devi R, Girigoswami A, Siddharth M, Girigoswami K. Applications of Gold and Silver Nanoparticles in Theranostics. Appl Biochem Biotechnol. 2022 Sep;194(9):4187–219.

7. Shukla AK, Iravani S. Green Synthesis, Characterization and Applications of Nanoparticles. Elsevier; 2018. 548 p.

8. Voliani V. Gold Nanoparticles: An Introduction to Synthesis, Properties and Applications.

Walter de Gruyter GmbH & Co KG; 2020. 113 p.

9. Thirupathi A, Guzzatti MFM, Corrêa MEAB, Venturini LM, Casagrande L de R, Lima IR, et al. Green Synthesis of Gold Nanoparticles with Curcumin or Açai in the Tissue Repair of Palatal Wounds. Antioxidants (Basel) [Internet]. 2023 Aug 7;12(8). Available from: http://dx.doi.org/10.3390/antiox12081574

10. Bhardwaj M, Sali VK, Malarvizhi R, Mani S, Padmavathy TK, Vasanthi HR. Methyldecanoate isolated from marine algae Turbinaria ornata enhances immunomodulation in LPS-induced inflammatory reactions in RAW 264.7 macrophages via iNOS/NFκB pathway. Inflammopharmacology. 2023 Feb;31(1):439–49.

11. Dhara S, Chakraborty K. Novel Furanyl-Substituted Isochromanyl Class of Anti-Inflammatory Turbinochromanone from Brown Seaweed Turbinaria conoides. Chem Biodivers. 2022 Jan;19(1):e202100723.