Synthesis Of Iron Nanoparticles From Halophila Ovalis Seagrass And Their Antioxidant Activities.

Wajeeha Alisalih, Pitchiah Sivaperumal, R. Gayatri Devi, S. Muthamizh*

Department of Physiology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Science (SIMATS) Saveetha University, Chennai, India.
Marine Biomedical Research Lab & Environmental Toxicology Unit Cellular and molecular research centre, Department of Prosthodontics,Saveetha Dental College and Hospitals, Saveetha Institute of Medical & Technical Sciences, Saveetha University, Chennai 600077, Tamil Nadu, India.

ABSTRACT:

Ecological biosynthesis of nanoparticles (NPs) are gained much interest among researchers. In present investigation, iron nanoparticles were synthesized via green synthesis method using Halophila ovalis seagrass extract, having the capacity of reducing iron ions to iron nanoparticles. Synthesis nanoparticles was confirmed by UV-vis spectroscopy, Scanning electron microscope (SEM) with EDS anlysis, Distribution of the elements were characterized by Elemental mappling in SEM analysis. Antioxidant activities of synthesis nanoparticles were measured against 2,2-diphenyl-1-picryl-hydrazyl (DPPH), TAA and TAP.

Keywords: Halophila ovalis, Iron nanoparticles, Seagrass, Antioxidant.

1. INTRODUCTION

Size and shape controlled nanoparticles were developed by various synthetic method, since the discovery of nanotechnology. Manipulation of materials with dimensions in the small range of 1 to 100 nm in their construction and design is a nanofabrication process. In general, there are two methods for the synthesis of nanomaterial's by top-down and bottom-up methods. Nanoparticle synthesis was done by several methods namely chemical and physical such as hydrothermal, supercritical fluid synthesis, microwave method, pyrolysis, sol-gel transition, engraving, ball milling, ablation laser, solid state synthesis and lithography respectively. [1-5] Most of the above synthesis method involves toxic solvents, due to this great effort has been taken to develop the green synthesis method for the synthesis of nanoparticles. Green synthesis methods are less expensive, less toxic and opens a way for the production of crystalline nanoparticles which possess a dissimilar shapes and sizes. The plant environment and metal salt extract, pH of the reaction medium, the parameters like temperature, mixing rate of precursor and plant extract and reaction time. Seagrasses are kind of plants which grows under the sea water, with high growth rate except in polar region than tidal and sub tidal marine surroundings. Clonal plants that can form patches or dense beds in the littoral zone of temperate and tropical seas are known as sea grasses. They provide food and habitats for organisms and affect biogeochemical and sedimentary processes. Halophila ovalis is a dioecious seagrass, which is distributed widely in the tropical indo-west pacific. It is also found in some areas outside the tropics. In shallow coastal waters, Seagrass beds are measured as one of the most significant biotic communities as they provide numerous ecological functions and services. In addition, owing to their ability to concentrate a wide range of toxic pollutants, Biomonitoring of toxic chemical contamination are employed by sea grasses. Halophila ovalis is one of the sea grass which contains higher bioactive compounds, which play a role of both reducing and capping agent. Due to its high antioxidant additive is restricted, we could end up with different morphology of nanoparticles. [6-10] Our team has extensive knowledge and research experience that has translate into high quality of publications [11–23].

Present study mixed phase of Iron nanoparticle's were synthesized using natural sea grass by green synthesis method and formation was confirmed by various characterization technique and utilized for the investigation of antioxidant property against DPPH assay.

2. Materials and Methods:

2.1. Materials

From Sigma Aldrich Iron(III) chloride hexahydrate ($FeCl_3.6H_2O$), methanol (CH_3OH) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) were purchased, other than the above were analytical grade chemicals used during chemical process. The *Halophila ovalis* saegrass were collected from Tuticorin district, Tamil Nadu.

2.2. Preparation of extracts and nanoparticle manufacture

Saegrass samples were collected from Tuticorin district. The collected seagrass was cleaned using double distilled water, and allowed to drying at shade until it completely dry. The dried samples are crushed using mortar and pestle to attain the powder. Aqueous solution of powder seargrass (50 g) was made with solvent extraction method and kept in an orbital shaker for 24 hours. The solutions was collected and filtered the filtrate was subjected to rotary evaporator to reduce the concentration of the extract to get crude samples. Synthesis of iron nanoparticles were done by using above synthesized cured extract. 10mM of aqueous solution of $FeCl_3.6H_2O$ was taken in a conical flask, then 10ml of aqueous extract of seagrass was added and allowed to chemical reduction process. Visible change of color was observed for the initial and final solution of reaction medium from green to dark brown which indicates the formation of Iron nanoparticles shown in Fig.1. The above solution was subjected to centrifugation at 1200 rpm and the final Nps was collected after several wash with distilled water and ethanol.

Fig.1. Preparation of extracts and green synthesis of Fe nanoparticle.

3. Result and Discussion

3.1.UV absorption spectroscopy

Ferric chloride solution were added to the seagrass extract of *Halophile ovalis*, we could able to observe the rapid colour change in the reaction medium from light brown to darck black, representing the formation of Fe NPs, The synthesized nanoparticles where observed by UV-Vis spectroscopy and results are represented in Figure 2. Two characteristic absorption peaks of ferric chloride solution with saegrass extract were obtained at 320 nm and 400 nm from UV analysis, upon being treated with *Halophila ovalis* extracts treated for 2 min not shown much difference, the absorption maximum were shift to 321 nm and 373 nm. The shift is observed due to surface plasmon, which indicates the transformation of ferric ion to Fe nanoparticles. From the above result it is evident that the saegrass extract has the ability of reducing the Fe ions to Fe Nps. The results are in agreement with previous reports and the slight variation of peaks in the results may be corresponds to the presence of various biomolecules in the plant. [24]

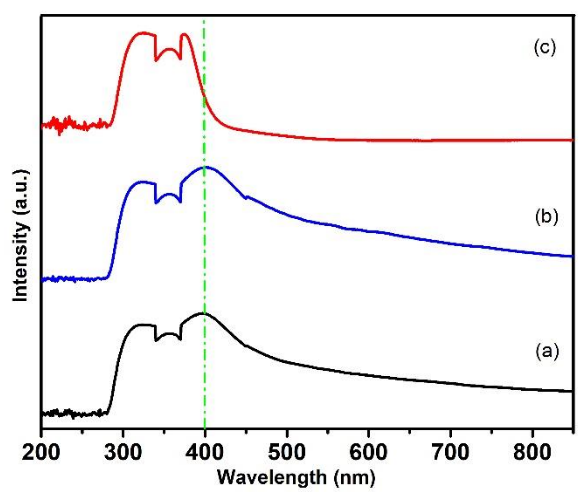
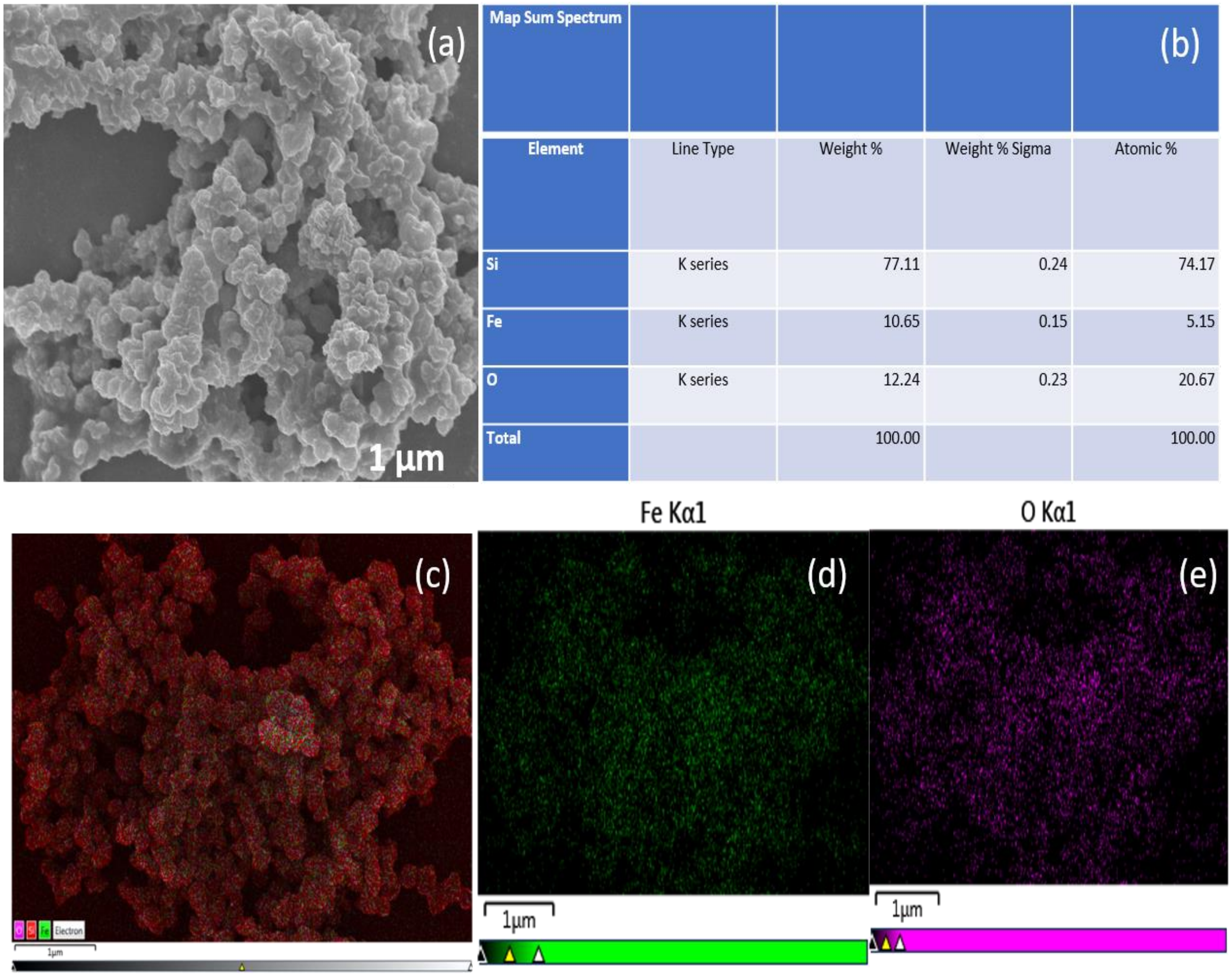


Figure 2(a-c). UV spectrum of *Halophila ovalis* with $FeCl_3.6H_2O$, 2 min treated and Fe and Fe_2O_3 NPs Respectively.

3.2. Morphological Analysis

Morphology of biosynthesized Fe nanoparticles were analyzed by SEM with EDS analysis. Obtained images are shown in Fig 3(a-e). We found the irregular morphology of samples with nano sized. In the EDS analysis we found Fe, O and Si. Presence of Si is due to the sample preparation for SEM analysis on Silica substrate and O due to the partial formation of Iron oxide when the biosynthesized Fe is exposed to atmosphere. Elemental mapping of the samples are done in order to identify the distribution of elements in NPs and shown in Fig 3(c-e). [25]

ISSN 2515-8260 Volume 09, Issue 08, 2022



Map Sum Spectrum				
Element	Line Type	Weight %	Weight % Sigma	Atomic %
Si	K series	77.11	0.24	74.17
Fe	K series	10.65	0.15	5.15
O	K series	12.24	0.23	20.67
Total		100.00		100.00

Figure 3(a-e). Morphology, EDS, Elemental mapping, Fe and O of Fe and Fe_2O_3 NPs Respectively.

3.3. Antioxidant assays

3.3.1. DPPH Assay

The 2,2-diphenyl-1-picrylhydrazyl (DPPH) was used as extensively as free radicals to estimate reducing agent and are valuable reagents for examining the scavenging activities of free radical in compounds. Synthesized nanoparticles was utilized for the evolution of antioxidant property at different concentration like 25, 50, 75, 100 µg/ml. An antioxidant activity was monitored by measuring the variation in the absorbance of DPPH radical at 517nm. The extract with methanol of *Halophila ovalis* displayed the DPPH radical scavenging activity and 50 % of the scavenging activity was found at the 100 µg/mL concentration. (Fig 4(a)). By increasing the

ISSN 2515-8260 Volume 09, Issue 08, 2022

concentration of Fe nanoparticles we are able to see the increase in scavenging activities in DPPH assays.

3.3.2. Phosphomolybdenum method (TAA)

The total antioxidant activity of synthesized Fe Nps was examined by Phosphomolybdenum method and the results are shown in Fig 4(b). In this method, the oxidation sate of Mo (VI) was reduced to Mo (V) by adding the Fe Nps through the formation of phosphate/Mo (V) complex. The total antioxidant activity increased with increasing concentration (25–100 µg/mL). Among various concentration of Nps 100 µg/mL shows the higher (60 %) of antioxidant activity.

3.3.3. The reducing power (TAP)

The reducing power of Synthesized Fe Nps is represented in Fig 4(c). As shown in Fig 4 (c), the reducing power was directly proportional to the concentration of nanoparticles. The inhibition percentage was increased with concentration increased from 25–100 µg/mL. [26-28]

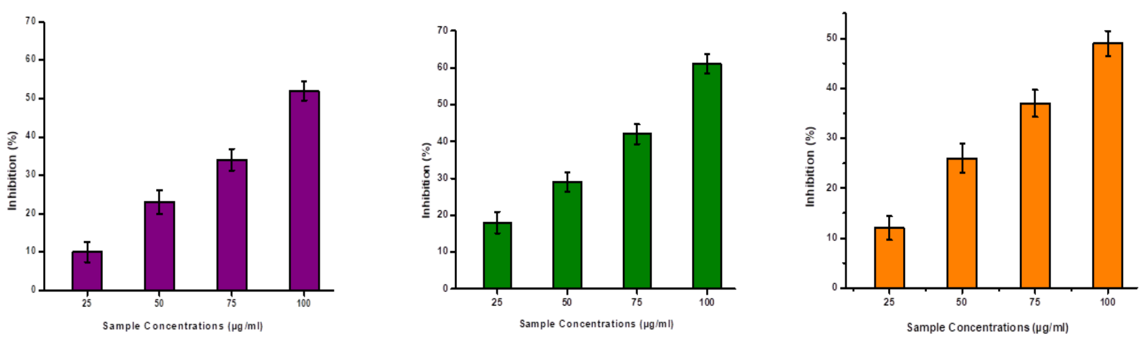


Figure 4(a-c). The different concentration of methanol extract of seagrass H. ovalis towards the DPPH radical scavenging activity (%),were represented.

4. Conclusion:

In conclusion, our investigation showed that the crude extraction of *Halophila ovalis* seagrass and utilized it for biosynthesis of Fe Nps. UV analysis confirms the formation of Fe Nps and morphology, elemental analysis and distribution of sample was observed by SEM analysis with EDS and mapping. The seagrass extract of H. ovalis mediated synthesized Fe Nps was found to be a capable candidate as antioxidant agent.

References

1. Nathan R, Schurr F, Speigel O, Steinitz O, Trakhtenbrot A, Tsoar A (2008) Mechanisms of long-distance seed dispersal. Trends in Ecol Evol 23: 638–647.

2. Janzen D (1970) Herbivores and the number of tree species in tropical forests. Am Nat 104: 501–528.

3. Connell J (1970) On the role of natural enemies in preventing competitive exclusion in some marine animals and in rain forest trees In: Den Boer P, Gradwell G, editors. Dynamics of Population. Wageningen: Pudoc.

4. Royo A, Carson W (2008) Direct and indirect effects of a dense understory on tree seedling recruitment in temperate forests: habitat-mediated predation versus competition. Can J Forest Res 38: 1634–1645.

5. Opdam P (1991) Metapopulation theory and habitat fragmentation—a review of holarctic breeding bird studies. Landscape Ecol 5: 93–106.

6. Thomson F, Moles A, Auld T, Ramp D, Ren S, Kingsford RT (2010) Chasing the unknown: predicting seed dispersal mechanisms from plant traits. J Ecol 98: 1310–1318.

7. Nilsson C, Brown R, Jansson R, Merritt D (2010) The role of hydrochory in structuring riparian and wetland vegetation. Biol Rev 85: 837–858. doi:

8. Clark C, Poulsen J, Bolker B, Connor E, Parke V (2005) Comparative seed shadows of bird-, monkey-, and wind-dispersed trees. Ecology 86
9. Wilkinson D (1997) Plant colonization: Are wind dispersed species really dispersed by birds at larger spatial and temporal scales? J Biogeogr 24: 61–65.

10. Kendrick G (2012) The central role of dispersal in the maintenance and persistence of seagrass populations. Bioscience 62: 56–65.
11. Jain AR. Prevalence of Partial Edentulousness and treatment needs in Rural Population of South India. World J Dent. 2017 Jun;8(3):213–7.
12. Kumar S. The emerging role of botulinum toxin in the treatment of orofacial disorders: Literature update. Asian J Pharm Clin Res. 2017 Sep 1;10(9):21.
13. Sivamurthy G, Sundari S. Stress distribution patterns at mini-implant site during retraction and intrusion--a three-dimensional finite element study. Prog Orthod. 2016 Jan 18;17:4.
14. Kumar MS, Vamsi G, Sripriya R, Sehgal PK. Expression of matrix metalloproteinases (MMP-8 and -9) in chronic periodontitis patients with and without diabetes mellitus. J Periodontol. 2006 Nov;77(11):1803–8.
15. Azeem RA, Sureshbabu NM. Clinical performance of direct versus indirect composite restorations in posterior teeth: A systematic review. J Conserv Dent. 2018 Jan;21(1):2–9.

16. Krishnan V, Lakshmi T. Bioglass: A novel biocompatible innovation. J Adv Pharm Technol Res. 2013 Apr;4(2):78–83.
17. Sekar D, Lakshmanan G, Mani P, Biruntha M. Methylation-dependent circulating microRNA 510 in preeclampsia patients. Hypertens Res. 2019 Oct;42(10):1647–8.
18. Felicita AS, Chandrasekar S, Shanthasundari KK. Determination of craniofacial relation among the subethnic Indian population: a modified approach - (Sagittal relation). Indian J Dent Res. 2012 May;23(3):305–12.
19. Neelakantan P, Subbarao C, Subbarao CV, De-Deus G, Zehnder M. The impact of root dentine conditioning on sealing ability and push-out bond strength of an epoxy resin root canal sealer. Int Endod J. 2011 Jun;44(6):491–8.
20. Jain RK, Kumar SP, Manjula WS. Comparison of intrusion effects on maxillary incisors among mini implant anchorage, j-hook headgear and utility arch. J Clin Diagn Res. 2014 Jul;8(7):ZC21–4.
21. Johnson J, Lakshmanan G, M B, R M V, Kalimuthu K, Sekar D. Computational identification of MiRNA-7110 from pulmonary arterial hypertension (PAH) ESTs: a new microRNA that links diabetes and PAH. Hypertens Res. 2020 Apr;43(4):360–2.
22. Keerthana B, Thenmozhi MS. Occurrence of foramen of huschke and its clinical significance. J Adv Pharm Technol Res. 2016;9(11):1835.
23. Lakshmi T, Krishnan V, Rajendran R, Madhusudhanan N. Azadirachta indica: A herbal panacea in dentistry - An update. Pharmacogn Rev. 2015 Jan;9(17):41–4.
24. Les D, Crawford D, Kimball R, Moody M, Landolt E (2003) Biogeography of discontinuously distributed hydrophytes: A molecular appraisal of intercontinental disjunctions. Internat J Plant Sci 164: 917–932.
25. Les D, Cleland M, Waycott M (1997) Phylogenetic studies in Alismatidae, II: Evolution of marine angiosperms (seagrasses) and hydrophily. Syst Bot 22: 443–463.
26. Harwell M, Orth R (2002) Long-distance dispersal potential in a marine macrophyte. Ecology 83
27. Lacap C, Vermaat J, Rollon R, Nacorda H (2002) Propagule dispersal of the SE Asian seagrasses Enhalus acoroides and Thalassia hemprichii. Mar Eco Prog Ser 235: 75–80.
28. Källström B, Nyqvist A, Åberg P, Bodin M, André C (2008) Seed rafting as a dispersal strategy for eelgrass (Zostera marina). Aqua Bot 88: 148–153.