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RESEARCH

Size-tunable *Sargassum polycystum* mediated synthesis of silver nanoparticles and its larvicidal effect on *Aedes aegypti*

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Abstract

One-pot green synthesis of silver nanoparticles (AgNPs) utilising marine brown seaweed (*Sargassum polycystum*) extract was developed. In this study, the size profile of the silver nanoparticles produced is investigated and it is found to be tunable by varying the synthesis parameters such as concentration of seaweed extract, concentration of silver nitrate, temperature, and pH. Various instrumentation and techniques such as Ultraviolet–Visible (UV–Vis) spectroscopy, dynamic light scattering (DLS), x-ray diffraction (XRD), energy dispersive x-ray spectroscopy (EDX), Fourier-transformed infrared spectroscopy (FT-IR) and high resolution transmission electron microscope (HR-TEM) were used to characterise the AgNPs. The findings shows that varying pH, temperature, and silver nitrate ($AgNO_3$) concentration in the reaction resulted AgNPs with different sizes. While controlling the ratio between the $AgNO_3$ and seaweed concentration greatly affects the polydispersity index (PDI) of the produced AgNPs. In this study, small size AgNPs with 0.72 ± 0.02 nm and PDI 0.581 ± 0.014 as detected by DLS analysis can be produced under reaction conditions of pH 11 and 85 °C. Besides that, the larvicidal potential of AgNPs was studied against Instar III *Aedes agypti* larvae with a tested concentration range of 20–100 ppm. The LC_{50} against *A. aegypti* larvae were found to be 103.10 ppm at 24 h and 46.67 ppm at 48 h. In addition, the synthesised AgNPs exhibit very low toxicity against non-target species *Artemia salina.* The outcome of this study has provided insights towards the significance of tuning various synthesis conditions to produce small sized and improved polydispersity of the AgNPs. The study has also revealed the potential use of the seaweed mediated synthesized AgNPs to control *Aedes* mosquito larvae population whilst not harming the non-target species such as brine shrimp, *Artemia salina.*

Keywords Silver nanoparticles · *Sargassum polycystum* · Phaeophyceae · Larvicidal · *Aedes aegypti*

Introduction

Silver nanoparticles (AgNPs) display unique properties in optical activity, chemical stability, good conductivity, catalytic ability, heavy metal detection, antibacterial, antifungal, antioxidant, anti-inflammatory and anti-cancer (Thangaraju et al. 2012; David et al. 2014; Rajeshkumar et al. 2014; Madhiyazhagan et al. 2015; Kharat and Mendhulkar 2016; Prosposito et al. 2016; Satapathy et al. 2017; Ahamad et al. 2021). The need to control the shape, size, and composition of AgNPs is crucial as these characteristics give them their unique physico-chemical properties. To date, there has been increasing interests to synthesise AgNPs using biological resources as the synthesis does not require the use of toxic and hazardous chemicals, high temperature, and pressure compared to physical and chemical methods (Prabhu and Poulose 2012; Kaabipour and Hemmati 2021).

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