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Dynamic Light Scattering of *Chlorogloeopsis fritschii* BK (MN968818) Mediated Zinc Oxide Nanoparticles at different Temperatures

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ABSTRACT: The present study is to optimize an eco-friendly and cost-effective mode to rapidly synthesize zinc oxide nanoparticles (ZnO NPs) through *Chlorogloeopsis fritschii* BK (MN968818) aqueous extracts and confirm ZnO NPs synthesis via dynamic light scattering (DLS) analysis. Nanoscale technology has emerged as a new field of study, synthesizing nanoparticles for various applications, including catalysis, electrochemistry, biomedicine, pharmaceutics, and food technology. A more comprehensive range of microbiota has been used in the biosynthesis of nanoparticles, with cyanobacteria proving to be a precious source due to their bioactive compound content. An attempt has been made to optimize temperature for biosynthesizing ZnO NPs using *Chlorogloeopsis fritschii* BK (MN968818).

Keywords: Cyanobacteria, biosynthesis, zinc oxide nanoparticle, dynamic light scattering.

I. INTRODUCTION

Nanoscale technology is a new field of study that involves creating nanoparticles for various applications such as catalysis, electrochemistry, biomedicine, pharmaceutics, and food technology [1]. Nanoparticles are synthesized via physical and chemical mechanisms such as photochemical, radiation, and chemical precipitation. However, using these processes is not environmentally friendly, expensive, or risky [2]. NPs, on the other hand, can be made via a biosynthetic approach that involves plant extracts and microbial communities (bacteria, fungi, algae, etc.). Physical and chemical procedures are more harmful than this method [3]. It's biocompatible, affordable, and safe [4]. Environmental safety is a critical component of a sustainable climate, is a top priority, and plays a more prominent role in illness prevention and healthcare-associated infections [2]. Adopting green and environmentally friendly synthesis processes has facilitated the development of NPs for use in consumer healthcare, space, food, and the cosmetic industry.

Furthermore, nanoparticles reduce antibiotic misuse, which is mainly used to treat pathogenic strains. Inorganic metal oxide nanoparticles including TiO_2, CuO, and ZnO have been produced and used in several studies to cure infectious and fatal diseases. Metal oxide nanoparticles like ZnO NPs are popular since they're easy to make and prepare. Furthermore, it is an n-type semiconducting metal oxide that has sparked a lot of attention in biomedical systems in recent years due to its wide range of uses. The ZnO is a GRAS (generally recognized as safe) metal oxide by the US FDA [5]. Traditional medications can be replaced with a bio-based ZnO NP, a more environmentally friendly alternative. Natural goods' potential has been recognized in agrochemicals and pharmaceuticals as the use of natural products has grown. They could be a new source of bioactive chemicals for metal ion reduction and disease control in plants and humans [6]. Because they contain various bioactive compounds, plants, algae, and microorganisms are promising candidates for nanoparticle synthesis [7]. Among all microorganisms, cyanobacteria are of particular interest in synthesizing NPs because they represent a potential source of novel chemicals with substantial biotechnological value [5]. In this study we have optimized the temperature sufficient for the formation of ZnO NPs.

II. MATERIAL AND METHODS

Synthesis of ZnO NPs in a green manner utilizing the cell-free extract. A 75ml zinc acetate dihydrate [Zn $(CH_3COO)_2 \cdot 2H_2O$)] precursor (2Mm). The solution was combined with 25 mL of cyanobacterial extract and stirred for an hour at 85°C, 70°C, 65°C, and 58°C at 150rpm. It was then collected and washed several times using ultrapure water and dried at 60°C for 24 hours, and green synthesized ZnO NPs were obtained by heating at 100°C for 8 hours [8, 9].

Dynamic light scattering (DLS) analysis for ZnO NPs. At the Institute of life science, Bhubaneswar, India, a "particle size analyzer" (Malvern zeta sizer) was utilized to measure the surface charge and size distribution of ZnO NPs.

III. RESULT AND DISCUSSION

Understanding nanoparticle growth mechanisms is crucial for synthesizing nanocrystals with desired biological and chemical properties. ZnO nanoparticles (NPs) were prepared by the green synthesis method in this work.

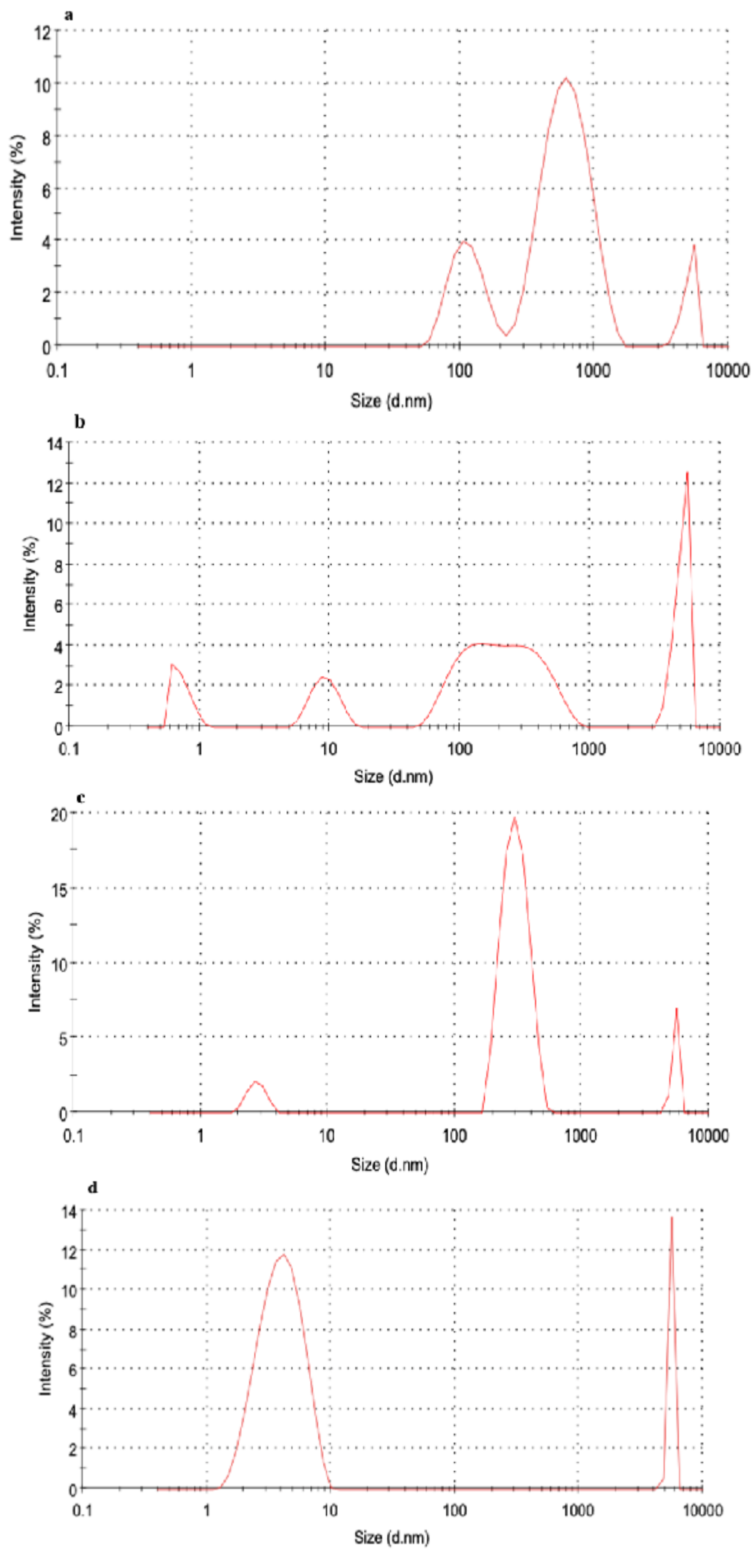

Fig. 1. Particle size distribution obtained at different temperature (a) average particle size at 85°C; (b) 70°C; (c) 65°C; (d) 58°C.

Dynamic light scattering (DLS) systematically studied the size evolution of ZnO NPs in an aqueous solution. Fig. 1 (a) reflects the average particle size of 387.5nm obtained at 85°C with a polydispersity, using 0.1 m mol of zinc acetate dihydrate. Fig. 1 (b) showed the average particle size of 539.3 nm obtained at 70°C with polydispersity. Fig. 1 (c) shows that the average particle size of 529.4 nm was obtained at 65°C with polydispersity. Figure 1 (d) showed an average size of 920.0nm at 58°C. A similar observation was reported by Markus *et al*. (2016) [10] in which the gold nanoparticles synthesized using probiotic *L. kimchicus* DCY51 were observed to be entirely poly-dispersed with sizes varying from 40 to 300 nm. Similar work was reported by another author while synthesizing ZnO NPs using the cell-biomass (CB) and supernatant (CFS) of zinc-tolerant *Lactobacillus plantarum* TA4 in a polydispersity state [11]. Furthermore, due to measurements performed from the metal core to the biological compound bonded to the particle surface, the hydrodynamic size of both biosynthesized ZnO NPs had a large diameter [10], as a result, their larger sizes are reflected.

CONCLUSION

This work opens a way to understand how the size of the NPs gets influenced by the employed temperature used during the green synthesis of ZnO NPs using the cyanobacterium *Chlorogloeopsis fritchii* BK (MN968818). The temperature between 60 and 70°C was found to be sufficient for the formation of ZnO NPs. Further, a deeper understanding of the synthesis of ZnO NPs in the laboratory for various sizes can be used for diverse applications.

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