

# **Biosynthesis of CuFe<sub>2</sub>O<sub>4</sub>/Ag nanoparticle by *Chlorella vulgaris* and assessment the effect of its on *norA* gene expression in *Staphylococcus aureus* bacteria**

Nakisa Kehzad\*,

**Introduction and objective:** *Staphylococcus aureus* is gram positive cocci with many virulence factors that can achieve resistance to antibiotics. Identification of antibiotic resistant species and study of the release of these species is important for determining the epidemiology and control of infections caused by this bacterium. One of the ways to cope with this bacterium is to develop empirical biological processes for the synthesis of nanoparticles, which has become an important branch of nanotechnology. The benefits of nanoparticles biosynthesis are the lack of use of high pressure, energy, temperature and toxic chemicals. Among alimentary factors, algae have a better position because these marine resources are naturally available and have important photochemical resources, also they produces nanoparticles that are highly stable and easy to manipulate. It seems that the use of metal nanoparticles is effective in reducing the prevalence of microbial diseases. Accordingly, in this study, the effect of CuFe<sub>2</sub>O<sub>4</sub>/Ag nanoparticle synthesized by *Chlorella vulgaris* on *norA* gene expression was investigated in *Staphylococcus aureus*. **Methods:** In this study, biosynthesis of CuFe<sub>2</sub>O<sub>4</sub>/Ag nanoparticles was confirmed by FTIR, XRD, EDX, and SEM tests. In addition, the minimum inhibitory concentration of ciprofloxacin and the nanoparticles were determined in the isolated ciprofloxacin-resistant *Staphylococcus aureus* strains by MIC. In the end, the *norA* gene expression was examined through the Real-Time PCR molecular method. **Results:** The results showed that expression of *norA* gene in the standard strain of *Staphylococcus aureus* in the presence of ciprofloxacin, CuFe<sub>2</sub>O<sub>4</sub>/Ag nanoparticles and both, decreased by 53%, 35% and 65%, respectively. Furthermore, these values for pathogen strains were 46%, 37% and

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**59%, respectively. Conclusion: In general, the results of this study showed that in order to increase the antibiotic effect of ciprofloxacin on Staphylococcus aureus, this antibiotic can be combined with CuFe<sub>2</sub>O<sub>4</sub>/Ag nanoparticle biosynthesized by Chlorella vulgaris algae, to achieve results in terms of S. aureus growth decline.**

**Keywords : Keywords: Staphylococcus aureus, Ciprofloxacin, CuFe<sub>2</sub>O<sub>4</sub>/Ag, norA**

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