Biosynthesis of Fe3O4 / Ag nanoparticle using Chlorella vulgaris algae extract and its impact on the pattern of norA gene expression in Staphylococcus aureus bacteria isolates hospitals

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Staphylococcus aureus is one of the most common causes of bacterial infections in hospitals, which causes antibiotic resistance to antibiotics to stop using antibiotics to treat these infections. There are several mechanisms for resistance to Staphylococcus aureus, one of which is the existence of an epileptic pump in this bacterium. By increasing antibacterial resistance to bacteria, the use of metal nanoparticles to combat bacterial infections can be effective as an alternative to antibiotics. Studies have shown that bioavailability of nanoparticles can be a suitable method for replacing chemical synthesis methods due to greater environmental compatibility and increased toxic effects on bacteria. method: After collection of 25 bacterial strains of Staphylococcus aureus Rasht and Tehran hospitals, all isolates were identified using standard biochemical and laboratory methods. Antibiotic susceptibility patterns of the strains were determined by disc diffusion method with antibiotic penicillin, oxacillin, vancomycin, gentamicin, erythromycin, ciprofloxacin, chloramphenicol and tetracycline according to CLSI principles. The biological synthesis of Fe3O4 / Ag nanoparticles was performed with an aqueous extract of chlorella vulgaris algae. For confirmation and identification of nanoparticles, UV-Visible, FTIR, XRD, DRS, EDS, scanning electron microscopy (SEM) and transient electron microscopy (TEM)) used. Also, the minimum inhibitory concentration (MIC) of ciprofloxacin antibiotic and nanoparticles for ciprofloxacin-resistant bacteria was investigated by microdeleuco method. In order to confirm the presence of norA gene in cyproforoxacin-resistant Staphylococcus aureus, genomic DNA was extracted bacteria. After PCR with the

primers, the presence of norA gene bands in agarose gel was investigated. Subsequently, RNA extraction and cDNA synthesis were performed by Sinaclon Corporation Kit. Then, by Real-time PCR reaction, the expression of norAg genes in treated samples with ciprofloxacin and nanoparticles was investigated in comparison with the rRNA gene expression of 16s as a reference gene. findings: The highest antibiotic resistance was observed for gentamicin (52%), oxacillin (32%), ciprofloxacin (44%), vancomycin (92%), penicillin (24%), tetracycline (35%), chloramphenicol (76%), and Erythromycin (40%). The crystalline structure and size of the nanoparticles were confirmed by diagnostic tests and electron microscopic findings and were observed between 4 and 23 nm. Also, the highest frequency of MIC concentration (64%) was observed in samples treated with ciprofloxacin 512 and the highest frequency of MIC was (57%) in samples treated with 64 nanoparticles. The presence of norA gene in ciprofloxacin resistant bacteria was confirmed. In addition, the results of the Real Time PCR reaction showed that ciprofloxacin increased the 2.5 fold increase in the expression of the defective gene, and the nanoparticle resulted in a slight reduction in the expression of the genes, and the use of nanoparticles and cipro has led to a decrease in the efficacy of ciprofloxacin in the Bacteria stay. Discussion and conclusion: Studies have shown that antibiotic resistance is rising in Staphylococcus aureus, and since staphylococcus aureus causes a wide range of hospital infections in humans, it should be a good way to prevent this drug resistance and to prevent the progression of these infections. . In the meantime, nanoparticles are structures that destroy bacteria without producing resistance. Also, these studies show that nanoparticle bio-synthesis can be a good way to replace chemical methods due to greater environmental compatibility and increased toxic effect of nanoparticles on bacteria. In this study, the Fe3O4 / Ag nanoparticles synthesized with chlorella vulgaris algae can reduce norA gene expression in Staphylococcus aureus bacteria, which causes bacterial resistance to antibiotics, and it can be concluded that the combined use of nanoparticles with antibiotics can be a good solution for Treating diseases caused by bacteria resistant to antibiotics.

Keywords : Staphylococcus aureus, metallic nanoparticles, chlorella vulgaris, pumps forefolium, norA