Assessment of the effect of silver nanoparticle functionalized by thiosemicarbazon on biofilm formation and fimA gene expression in E. coli bacteria isolated urinary tract infections

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Escherichia coli drug resistance that is associated with urinary and nosocomial infections is increasing. E. coli also has the ability to produce biofilms. The biofilm structure protects the bacterial cells against host defense mechanisms and antibiotics. Various genes, including fimA, play a role in biofilm production. In order to combat with these pathogens, nanoparticles, and especially the active nanoparticles, have been considered. In the present study, the antibacterial effect of silver nanoparticle functionalized by thiosemicarbazon has been evaluated and the fimA gene expression under the influence of these substances was also assessed. For this purpose, the E. coli pathogen strains isolated with biochemical and microbial tests and then antibiotic resistance measurements were carried out using antibiogram and the ability to formation of biofilm was also studied. The synthesis of silver nanoparticle functionalized by thiosemicarbazon was also carried out and confirmed by XRD and FTIR techniques. Then with using MIC test, the inhibitory effect of silver nanoparticles, thiosemicarbazon and silver nanoparticle functionalized by thiosemicarbazon on standard and pathogenic E. coli was studied. Also, after extracting RNA the control samples and silver nanoparticle functionalized by thiosemicarbazon samples, and then cDNA synthesis, the fimA gene expression was determined by Real time PCR technique. MIC results showed that silver nanoparticle functionalized by thiosemicarbazon were effective in inhibiting growth of bacteria at low concentrations of 128 µg / ml and 256 µg / ml. While the inhibitory effect of silver nanoparticles was at 1024µg / ml. The results of Real Time PCR showed that in

standard samples of Escherichia coli, the silver nanoparticle functionalized by thiosemicarbazon reduced the expression of fimA by 40%, while in standard samples treated with silver nanoparticles, the gene expression increased by 5.1 times. However, the fimA gene expression increased in the pathogen strains treated with the silver nanoparticle and also silver nanoparticle functionalized by thiosemicarbazon, while the treatment with thiosemicarbazon alone reduced the expression of fimA by about 100%. In conclusion, silver nanoparticle functionalized by thiosemicarbazon have antimicrobial activity against Escherichia coli but at least for the pathogen isolates of this bacterium, this effect is not due to the reduction of fimA biofilm gene expression. Also compared to standard isolates, the E. coli pathogen isolates are likely to be mutated in the sequence of the fimA gene or in the sequence of the regulatory regions of this gene.

Keywords : Escherichia coli, Biofilm, fimA gene, Thiosemicarbazon, Silver nanoparticles