

# The combined effects of multisized silver nanoparticles and pulsed magnetic field on *K. pneumoniae*

El-Khatib, A.M.<sup>a</sup>, El-Kaliuoby, M.I.<sup>c</sup>, Elkhatib, M.<sup>b</sup>, Khalil, A.M.<sup>b</sup>

<sup>a</sup> Faculty of Science, Alexandria University, Alexandria, Egypt

<sup>b</sup> Faculty of Engineering, Pharos University in Alexandria, Alexandria, Egypt

<sup>c</sup> Faculty of Education, Alexandria University, Alexandria, Egypt

## Abstract:

Silver nanoparticles have been shown to have antimicrobial effects and remarkable disinfection efficacy against a range of water microorganisms. In the present work, *Klebsiella pneumoniae* was used as a water treatment model, as it survives in a wide range of water environments. Silver nanoparticles of higher stability and different sizes were synthesized by the arc discharge method. The combination of 30 min exposure to 0.32 mT, 20 Hz pulsed magnetic field and treatment with silver nanoparticles with serial concentrations (10:500 parts per million) and different sizes (94, 38 and 17 nm) was used to study the antibacterial effects against *K. pneumoniae*. Confirmation of silver nanoparticles by using an ultraviolet-visible spectrometer, a particle size analyzer and a high-resolution transmission electron microscope depicted three sizes (~94, ~38 and ~17 nm) at rotational speeds (0, 350 and 950 revolutions/min, respectively). The antibacterial results indicated serially more inhibition of bacterial growth with increase in silver nanoparticle concentration, with the maximum effect of more than 70% inhibition produced by 17 nm silver nanoparticles. Particularly, the combination of pulsed magnetic field and silver nanoparticles (17 nm) indicated significant enhancement in growth inhibition by 56.7% compared to each alone. The study presents a new trend for water disinfection with significant impact of such combination effects on *K. pneumoniae* with low silver nanoparticle concentrations and less toxicity. © 2019 ICE Publishing: All rights reserved.

## Reference:

<https://08105wt7q-1104-y-https-www-scopus-com.mplbci.ekb.eg/record/display.uri?eid=2-s2.0-85067703100&origin=resultslist&sort=plf-f&src=s&nlo=&nlr=&nls=&sid=6dd3353754fbaa1728196603627cd883&sot=aff&sdt=cl&cluster=scopubyr%2c%222018%22%2ct%2bbscosubjabbr%2c%22ENGI%22%2ct&sl=49&s=AF-ID%28%22Pharos+University+in+Alexandria%22+60011287%29&relpos=0&citeCnt=0&searchTerm=>