Available online at http://bjas.bajas.edu.iq
https://doi.org/10.37077/25200860.2023.36.2.12
College of Agriculture, University of Basrah

Basrah Journal of Agricultural Sciences

ISSN 1814 – 5868 Basrah J. Agric. Sci., 36(2), 144-174, 2023 E-ISSN: 2520-0860

Antibacterial Activity of Silver Nanoparticles Composed by Fruit Aqueous Extract of *Abelmoschus esculentus* (L.) Moench Alone or in Combination with Antibiotics

Ali A. Shareef*[1], Fadhil J. Farhan[2] & Fulla A. A. Alriyahee[1]

[1]Department of Biology, College of Education for Pure Sciences, University of Basrah, Iraq
[2]College of Marine Science, University of Basrah, Iraq
***Corresponding author email:** A.A.S.: aliaboud547@gmail.com; F.J.F.: fadhil.farhan@uobasrah.edu.iq; F.A.A.A.: fulla.abed@uobasrah.edu.iq

Received 24th May 2023; Accepted 18th Sept 2023; Available online 29th December 2023

Abstract: Nanoparticle applications are growing due to the unique properties that nanoparticles possess, which have gained the attention of researchers, and one of these applications is the use of inhibiting antibiotic-resistant bacteria. The current work aims to biosynthesize silver nanoparticles from the fruits of the okra plant *Abelmoschus esculentus* (L.) Moench and test their antibacterial activity alone or in combination with some antibiotics. The creation of silver nanoparticles was confirmed by altering the colour of the mixture from light green to dark brown, in addition to employing spectroscopic methods to prove and explain the production of these particles, such as UV-vis, FTIR, XRD, and EDX. Scanning electron microscopy (SEM) was used to determine the shape and sizes of the particles created in the current study. The synthesized silver nanoparticles were tested alone or in combination with some antibiotics for their ability to inhibit four species of antibiotic-resistant MDR bacteria, three of which were Gram-negative and the fourth was Gram-positive bacteria. The results demonstrated that these bacteria were inhibited when using nanoparticles at all concentrations alone or in combination with antibiotics. AgNPs were found to be more effective against Gram-positive bacteria than Gram-negative bacteria. Therefore, *Staphylococcus auricularis* (8F) was the most sensitive bacteria at all concentrations, while *Escherichia coli* (3R) was the most resistant. The results of the combination of AgNPs with some antibiotics revealed that the best synergy was recorded when AgNPs mixed with Amoxicillin clavulanate against all species of Gram-negative bacteria, followed by ciprofloxacin, Ampicillin, and Fosfomycin.

Keywords: AgNPs, Antibacterial Activity, Antibiotics combination.

Introduction

Many biologists, chemists, and researchers have observed a significant increase in nanotechnology research, driven by the unique properties and diverse applications of metal nanoparticles. These nanoparticles have shown their ability to kill or inhibit pathogenic bacteria that cause disease in humans and animals (Vanlalveni *et al.*, 2021). Almudhafar & Al-Hamdani (2022) demonstrated that silver nanoparticles made from plant extracts can suppress pathogenic bacteria and cancer cells. Nanotechnology is a rapidly emerging field that focuses on the fabricating nanoparticles ranging in size from 1 to 100 nanometers. Its broad-ranging applications extend multiple scientific disciplines, including medicine, environmental science, agriculture, and many others. One of the key advantages of