ROLE OF GRAPHENE OXIDE TO OVERCOME ANTIMICROBIAL RESISTANCE

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Introduction: There has been a huge increase in the incidence of multi-drug resistant species of pathogenic bacteria in the past decade. This has led to concerns and challenges in the healthcare sector because of the failure of the most commonly used antibiotics in effectively preventing and treating infections. Resistance to antibiotics could be intrinsic or acquired. The emergence of antimicrobial resistance requires a multidisciplinary approach:

(i) biomedical innovation

(ii) precise control of antibiotic consumption

(iii) inhibition of health-care- associated infections

(iv) prevention of spread of multidrug-resistant (MDR) bacteria

(v) elimination of clinical and veterinary misuse[1].

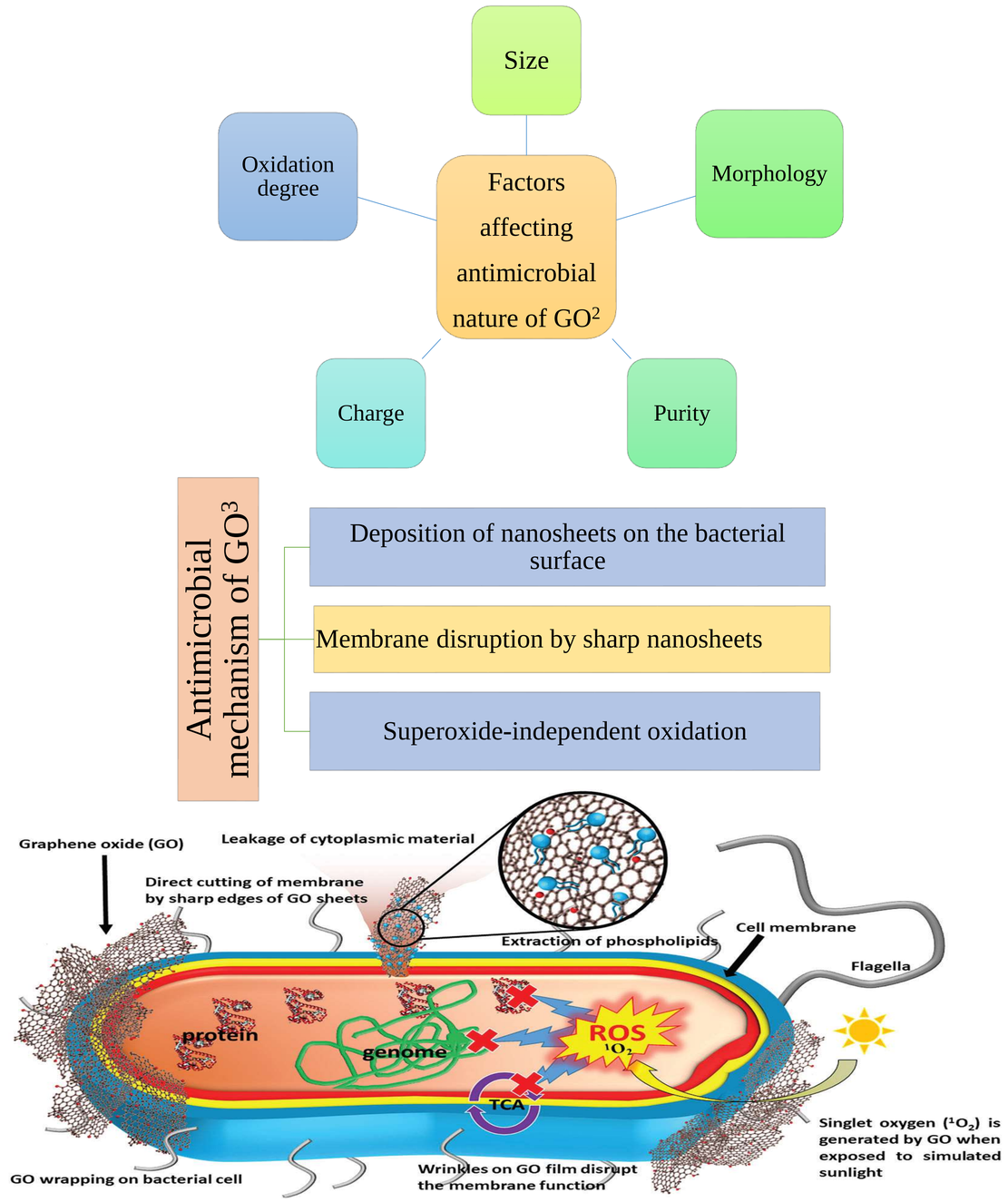

Fig1: Mechanism of Action of GO as an antimicrobial agent[3]

Antimicrobial nanoparticles (NPs) compared to conventional antibiotics have some obvious advantages that include low toxicity, overcome resistance and reduced cost. With the emergence of nanotechnology, many nanomaterials (NMs) with antibacterial properties have been produced to fill the gap of antibiotic treatment failure[4].

Graphene oxide : The effectiveness of graphene oxide as an antibacterial is probably due to its high surface area, great thermal stability, physiochemical properties, great electronic conductivity and mechanical power. The high antibacterial efficiency of graphene oxide is due to the damage of cell membranes via generation of reactive oxygen species (ROS) and exceptionally sharp edges of graphene oxide[3].

GO-Ag nanoparticles can unswervingly cause bacterial cell membrane damage, disrupt DNA replication, increase membrane permeability and ultimately result in cell death. Three possible mechanisms have been proposed:

- gradual release of silver ions that affects DNA replication and ATP production
- direct damage of cellular membranes by AgNPs
- generation of reactive oxygen species (ROS) from AgNPs and Ag.[5]

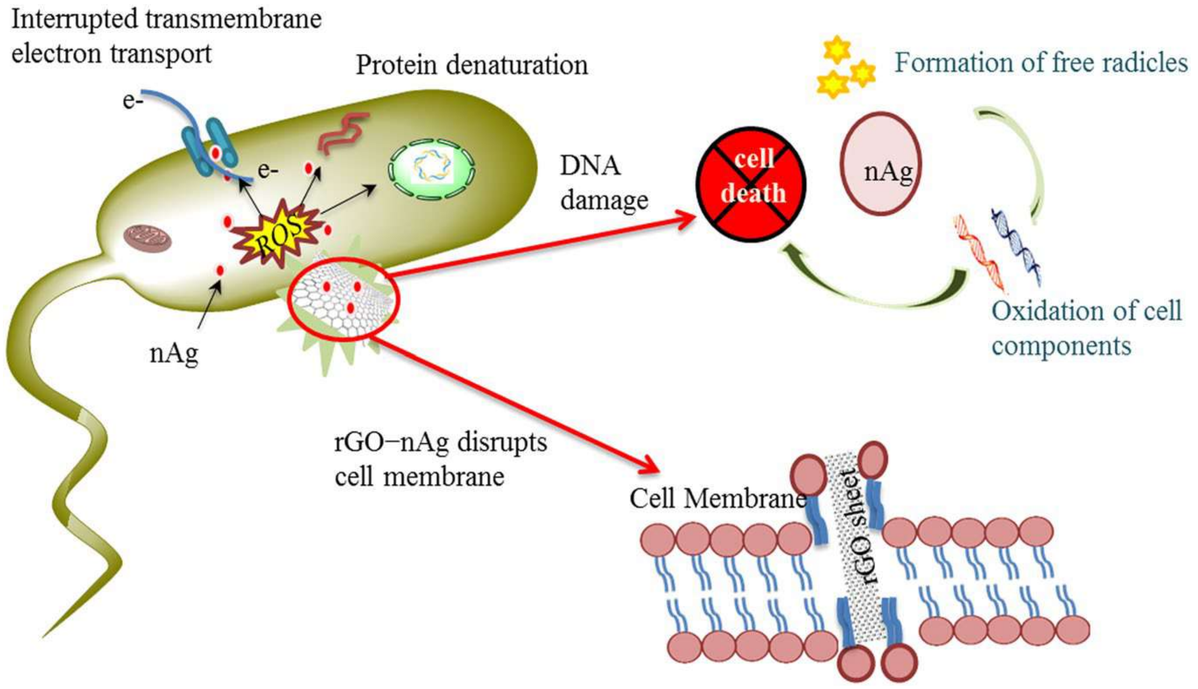

Fig2: Mechanism of Action of reduced GO-Ag NPs[5]

Conclusion: Graphene oxide (GO) based nanocomposites have shown high efficiency in antibacterial activity. The functionalization of graphene surface by different covalent strategies and the incorporation of inorganic nanostructures has enchanced the antibacterial efficiency of GO. Thus, it can be concluded that modified graphene structures provide highly efficient antibacterial systems in combating multidrug-resistant pathogens.

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