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Natural Products-Based Metallic Nanoparticles as Antimicrobial Agents

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Abstract

Natural products offer a wide range of bioactivity including antimicrobial properties. There are many reports showing the antimicrobial activities of phytochem icals from plants. However, the bioactivity is limited due to multidrug resistant properties of the microorganism and different composition of cell membrane. The antibacterial activity of the natural products is different toward Gram-negative and Gram-positive bacteria. These phenomena are caused by improper physicochemical conditions of the substance which hinder the phytochemical bioactivity against the broad range of bacteria. One of the strategies to improve the antimicrobial action is by biogenic synthesis via redox balance of the antimicrobial active substance with metal to form nanosized materials or nanoparticles (NPs). Antibiotic resistance is not relevant to NPs because the action of NPs is via direct contact with bacterial cell walls without the need of penetration into microbial cells. The NPs that have shown their effectiveness in preventing or overcoming biofilm formation such as silver-based nanoparticles (AgNPs), gold-based nanoparticles (AuNPs), platinum-based nanoparticles (PtNPs) and Zinc oxide-based nanoparticles (ZnONPs). Due to its considerably simple synthesis procedure has encouraged researchers to explore antimicrobial potency of metallic nanoparticles. Those metallic nanoparticles remarkably express synergistic effects against the microorganisms tested by affecting bacterial redox balance, thus disrupting their homeostasis. In this paper, we discuss the type of metallic nanoparticle which have been used to improve the antimicrobial activity of plant extract/constituents, preparation or synthesis process and characterisation of the plant-based metallic nanoparticles. Copyright © 2022 Susanti, Haris, Taher and Khotib.

Author keywords

antimicrobial; gold nanoparticle; green synthesis; nanoparticles; natural products; silver nanoparticle

Indexed keywords

EMTREE drug terms

alkaloid; amoxicillin; antibiotic agent; antiinfective agent; camphor; catalase; colistin; curcumin; ergosterol; exopolysaccharide; flavonoid; glutathione; gold nanoparticle; hydrogen peroxide; hydroxyapatite; metal nanoparticle; nanomaterial; nanoparticle; phytochemical; plant extract; platinum; polysaccharide; reactive oxygen metabolite; saponin; silver; silver nanoparticle; squalene monooxygenase; superoxide dismutase; superparamagnetic iron oxide nanoparticle; terpene; vancomycin; zinc oxide; zinc oxide nanoparticle

EMTREE medical terms

Aloe vera; Alternaria; anise; antibacterial activity; antibiotic resistance; antiinflammatory activity; antimicrobial activity; antineoplastic activity; apoptosis; atomic force microscopy; Bacillus subtilis; bacterial cell; bacterial cell wall; bacterial growth; biocompatibility; biofilm; biological activity; Brassica juncea; Candida albicans; Catharanthus roseus; cell membrane; cost effectiveness analysis; crystal structure; cytotoxicity; DNA damage; drug delivery system; drug synthesis; electromagnetic radiation; encapsulation; endophytic fungus; energy dispersive X ray spectroscopy; environmental factor; Escherichia coli; Euphorbia; fenugreek; Gardenia jasminoides; Gracilaria; Gram positive bacterium; high performance liquid chromatography; homeostasis; human; infrared spectroscopy; Jatropha curcas; Klebsiella oxytoca; marine environment; MCF-7 cell line; Mentha piperita; minimum inhibitory concentration; Morus alba; multidrug resistance; nanotechnology; nonhuman; oxidation reduction reaction; oxidative stress; particle size; Pelargonium; Persicaria; photoactivation; photon correlation spectroscopy; photothermal therapy; phytochemistry; plant leaf; protein structure; protein synthesis; Proteus mirabilis; Proteus vulgaris; Pseudomonas aeruginosa; Pseudomonas syringae; quorum sensing; Review; risk assessment; Salmonella enterica serovar Typhi; Salmonella enterica serovar Typhimurium; scanning electron microscopy; seaweed; signal transduction; Staphylococcus aureus; static electricity; Streptococcus pyogenes; synergistic effect; synthesis; transmission electron microscopy; X ray diffraction; zeta potential; zone of inhibition

Chemicals and CAS Registry Numbers

Unique identifiers assigned by the Chemical Abstracts Service (CAS) to ensure accurate identification and tracking of chemicals across scientific literature.

amoxicillin	26787-78-0, 34642-77-8, 61336-70-7
camphor	464-49-3, 76-22-2, 8008-51-3
catalase	9001-05-2
colistin	1066-17-7, 1264-72-8

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