Editorial

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Biomolecules-derived synthesis of nanomaterials for environmental and biological applications

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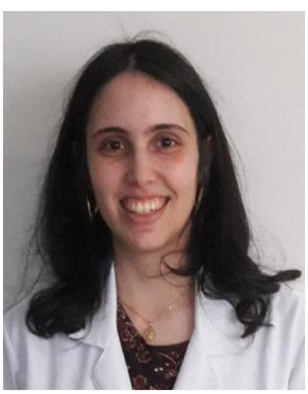

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Nanoscale favors the appearance of a high surface area-to-volume ratio and quantum effects that result in differences of properties when comparing the nanoparticles, for example, with the bulk material from which they have originated. Among the exceptional properties of these nanomaterials, it is possible to highlight remarkable catalytic activity, optical properties, electrical properties, and antibacterial activity.

Different synthetic approaches can be applied to synthesize nanomaterials. When it comes to metallic nanoparticles, the raw material can present larger dimensions that can be reduced by top-down techniques, or the synthesis can begin with ions that will be reduced and capped to originate the material in nanoscale. The protocol to be used to produce nanomaterials can be chemical, physical, physicochemical, or a green one. The latter, related to a biogenic synthesis, is currently gaining increasing attention in the realm of bio-nanotechnology. Using biogenic synthesis instead of chemical and/or physical one is more ecologically friendly, cost-effective, and eliminates the use of harmful chemicals. Consequently, there is a better chance for green nanomaterial synthesis (using plants, bacteria, fungi, algae, and waste materials) to provide a wide range of applications while also adhering to sustainability principles and offering the desired biocompatibility.

Therefore, biogenic nanomaterials present a large array of potential applications for example in environmental pollutant detection (nanosensors) and remediation, aiming to restore ecosystems, for example.

Tonelli et al. [1] reviewed the role of algae as a potential raw material for the synthesis of gold, silver, and iron nanoparticles. They discussed the ability of these nanoparticles (NPs) to cope with environmental toxins, their favorable traits, and biocompatibility, as well as the primary drawbacks to their widespread use and their prospects for the future.

Alqahtani et al. [2] used wet co-precipitation to synthesize disk-shaped zinc oxide nanoparticles that were functionalized with nicotinic acid (vitamin B3) and β-cyclodextrin (β-CD). The blue color solution was decolored at pH 6 over the course of 190 min by the ZnO/β-CD/nicotinic acid nanocomposite material, which demonstrated a photocatalytic effect against methylene blue. Additionally, it had antifungal and antibacterial effects against *Aspergillus niger* and *Streptococcus aureus*. The anticancer effects of the ZnO/β-CD/nicotinic acid nanocomposite against MCF-7 cell lines also attracted attention.

So, these materials offer a variety of biological applications, such as acting directly as active substances (serving as antimicrobial, catalyst, anticancer, nanoadsorbent, and antioxidant structures) or providing the opportunity for

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nanodelivery, detection of analytes, and bioimaging in diagnosis, for example.

Zhang et al. [3] reported encapsulation of tanshinone in poly(lactic-*co*-glycolic acid)-block-poly (ethylene glycol)-carboxylic acid (PLGA-PEG-COOH) nanoparticles, and evaluated its therapeutic efficacy on cerebral ischemia/reperfusion injury (CIRI). They found that PLGA-PEG-COOH-encapsulated tanshinone IIA plus angiopep-2 peptide holds a promising therapeutic potential toward CIRI.

Haq et al. [4] synthesized silver nanoparticles using ripened fruit extract of *Melia azedarach*. The size of the synthesized nanoparticles was 2–60 nm. The antibacterial activity and minimum inhibitory concentration against tested bacterial strains showed higher activity for NPs (*P. aeruginosa* ZI = 22). Synthesized silver nanoparticles also showed potential antioxidant activity, i.e., IC_{50} values of 2,2-diphenyl-1-picrylhydrazyl (DPPH) and 2,2-azino-bis-3-ethylbenzothiazoline-6-sulphonic acid were 40 and 58 $\mu g \cdot mL^{-1}$.

Mayegowda et al. [5] reviewed the role of green-synthesized nanoparticles and their therapeutic applications such as antimicrobial activity, anticancer activity, etc.

Sivasubramanian et al. [6] synthesized silver nanoparticles using leaf extract of *Cassia alata*. Furthermore, they evaluated antibacterial activity of silver nanoparticles against *Staphylococcus aureus*, *Klebsiella* sp., *Pseudomonas* sp., *Proteus* sp., and *Enterobacter* sp. They have also reported antioxidant potential and anticancer activity against human lung cancer cell lines (A549).

Nguyen et al. [7] synthesized silver nanoparticles using leaf extract of *Callisia fragrans*. The synthesized nanoparticles were evaluated for their anticancer activity against HepG2, MCF-7, LU-1, KB, and MKN-7 cell lines and the obtained IC_{50} values were 2.31, 2.41, 3.26, 2.65, and 2.40 $\mu g \cdot mL^{-1}$, respectively.

Huda et al. [8] synthesized silver nanoparticles using *Kickxia elatine* (KE) extract and checked its ability to inhibit acetylcholinesterase (AChE) in rat brain *ex vivo*. At 175 $\mu g \cdot mL^{-1}$, KE extract and AgNPs both exhibited detectable anti-AChE activity. It was determined that KE and AgNPs may be utilized as an inhibitor of rats' brain AChE, indicating that this medication may be employed as a less expensive and alternative treatment for conditions like Alzheimer's disease.

Muruganandham et al. [9] synthesized silver nanoparticles using flower petal extract of *C. alata*. They also optimized the production parameters such as metal ion concentration, pH, and concentration of substrate. They evaluated bioactivity against *Aspergillus fumigatus*, *Trichophyton rubrum*, *Epidermophyton floccosum*, *Candida albicans*, and *Mucor* sp. Furthermore, antioxidant properties of silver nanoparticles were assessed using DPPH assay and FRAP tests. Human fibroblast cell line (L929) was used to check the cell viability and cytotoxicity.

Kaliaperumal et al. [10] created a hydrogel using chitosan and polyvinyl alcohol derived from red cabbage and tested its effectiveness for use in wound healing and antibacterial activities. This hydrogel was different from other wound dressings that it could stay on the wound for a longer time, lessening discomfort and the need for frequent dressing changes, which would speed up the healing process.

Gaba et al. [11] by utilizing *Trichoderma asperellum* synthesized copper oxide nanoparticles and checked their effectiveness against the Alternaria blight of *Brassica* in two different soil types, alluvial and calcareous. M–CuO NPs at a 200 ppm concentration were applied as a protective layer, increasing the maximum plant height in both soils. Copper oxide nanoparticles were discovered to be the most efficient treatment for controlling illness, enhancing productivity, and enhancing Brassica's growth-promoting activities.

Shesayar et al. [12] proposed a model which computes the process necessities and expects the results. Based on the operative requirements, the proposed model offers suggestions which will be helpful for the medical researchers to identify the proper medical treatments based on the microbiological requirements.

Bhusari et al. [13] reported rapid one-pot synthesis of silver nanoparticles using the leaves of *Taxus wallichiana* Zucca in the presence of sunlight. Furthermore, the synthesized silver nanoparticles showed antioxidative, anticancer, anti-inflammatory, and antiurolithic properties.

Natrayan et al. [14] reported the recyclability and catalytic characteristics of copper oxide nanoparticles that were derived from bougainvillea plant flower extract. They evaluated its photocatalytic efficiency against Congo red, bromothymol blue, and 4-nitrophenol.

Sultana et al. [15] reported the synthesis of selenium–iron nanocomposites using *Allium sativum* and evaluated its antioxidant potential and antimicrobial activities against clinical pathogens such as *E. coli*, *S. aureus*, *A. flavus*, and *F. oxysporum*.

The Sustainable Development Goals need to receive attention on an urgent basis in order to improve life quality and achieve a development that respects ecosystems and communities worldwide aiming for prosperity and equilibrium. In this sense, this special issue presented green nanomaterials as strategic tools to help deal with challenging issues in an eco-friendly and efficient manner.

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