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Editorial

Nanoparticle-Induced Toxicities: An Update on the Role of Oxidative Stress

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The variety of nanoparticles has, unfortunately, become common constituents of the growing pollution problem. Since there is a significant presence of nanoparticles in the food industry, cosmetics, and other unavoidable products, better knowledge of their properties and undesirable effects seems necessary to reduce their adverse effects. Although nanoparticles induce numerous toxicities, some common pathways are harmful to human health, including oxidative damage. Significant impact of nanoparticles has previously been documented in clinical trials and preclinical investigations. Therefore, the objective of this special issue is to allow a comprehensive insight based on both original research and review articles that focus on the estimation of oxidative stress as the key point mechanism in many toxicities induced by nanoparticles. At the same time, numerous investigations confirmed the beneficial role of nanoparticles administration for many medical indications, with the final effects strongly depending on the applied methodology. Thus, to enlighten the complex impact of nanoparticles on targeting species, in this special issue, we are now offering an update to the existing information that can help to reveal our current knowledge from competent and reliable sources.

This special issue covers 10 articles focusing on nanoparticle-induced toxicities, highlighting the role of oxidative stress. The guest editors are pleased to present a compendium of these updates on nanoparticles' effects in the published articles as follows:

Potential benefits of nanotechnology in the field of cancer treatment were presented by Priyadarshini and coworkers in the article "Comparative in vitro Cytotoxicity Study of Carbon Dot-Based Organometallic Nanoconjugates: Exploration of Their Cell Proliferation, Uptake, and Localization in Cancerous and Normal Cells". The results obtained in this *in vitro* study confirmed that carbon dot-based nanoconjugates with Ag had potent therapeutic potential, signifying the effect of silver in cancer cell lines. At the same time, those nanoconjugates potentiated the nontoxic nature of human health cell line.

On the other hand, the adverse effects of specific nanoparticles were elaborated in the article "Exacerbation of thrombotic responses to silver nanoparticles in a hypertensive mouse model" by Ferdous and coworkers. Based on the results of this original research, the population with hypertension is at higher risk of the toxicity of polyethylene glycol-AgNPs. This conclusion appeared following the results that confirm that polyethylene glycol-AgNPs can potentially exacerbate the *in vivo* and *in vitro* procoagulatory and oxidative stress effect in hypertensive mice.

Although there is a lot of evidence considering nanoparticle-induced toxicities, potential benefits of their clinical usage highlight the necessity for treatment of their adverse effects, primarily by attenuation of this specific kind of iatrogenic oxidative damage. Therefore, the extensive overview of literature data presented in the article "An overview of the beneficial role of antioxidants in the treatment of nanoparticle-induced toxicities" by Mihailovic and colleagues offers the confirmation that nanoparticles-induced oxidative stress may be attenuated by different antioxidant substances. It is worth noting that naturally occurring antioxidants have an important role in the enhancement of the antioxidant defense systems in the prevention and mitigation of organism damage caused by

nanoparticle-induced oxidative stress. Naturally occurring antioxidant protection was also elaborated in detail in the insightful review article "Phyto-antioxidant functionalized nanoparticles: A green approach to combat nanoparticles-induced oxidative stress" by Balkrishna and colleagues. This review article, in turn, offers convincing evidence that nanoparticles may be useful in combating the oxidative damage of other origins. Namely, the majority of silver, gold, iron, zinc oxide, and copper nanoparticles produced utilizing various plant extracts were active free radical scavengers. According to the authors, this potential is linked to several surface-fabricated phytoconstituents, such as flavonoids and phenols, which accentuated the potential of phyto-antioxidant functionalized nanoparticles to be a better alternative to nanoparticles prepared by other existing approaches.

Interestingly, one of the most promising and state-of-the-art methodological approaches in the field of nanotechnology, the green synthesis of nanoparticles, had been the subject of several papers in this Issue. Mohanta and collaborators in the original article "Exploring dose dependent cytotoxicityprofile of *Gracilaria edulis* mediated green synthesized silver nanoparticles against MDA-MB-231 breast carcinoma" showed that silver nanoparticles synthesized through the extensively elaborated green method expressed potential anticancer and antimicrobial activity. This finding allows potential utility in the food preservative film industry, as well as biomedical and pharmaceutical industries. Another intervention performed on silver nanoparticles was presented in the original article "Anticancer, enhanced antibacterial and free radical scavenging potential of Fucoidan (*Fucus vesiculosus* Source) mediated silver nanoparticles" by Rajeshkumar and coworkers. Based on the results presented in this study, the activities of commercial antibiotics were enhanced by impregnation with the synthesized silver nanoparticles, which led to the conclusion that the utilization of environmentally synthesized silver nanoparticles offers numerous benefits of eco-friendliness and compatibility for biomedical applications. Even more beneficial impact of green methods in nanotechnology was presented in the original research "Evaluation of zebra fish toxicology and biomedical potential of *Aeromonas hydrophila* mediated copper sulfide nanoparticles" by Shanmugam and colleagues. The applied methodology resulted in the confirmation that *Aeromonashydrophila*-mediated copper sulfide nanoparticles can be considered as a potential candidate with therapeutic proficiencies as antibacterial, antioxidant, and anti-inflammatory agents. Innovative approaches in the application of nanotechnology were also the subject of the review by Rasouli and colleagues. The overview of data obtained in clinical studies presented in the article "Combining nanotechnology and gas plasma as an emerging platform for cancer therapy: mechanism and therapeutic implication" had been summarized in the way that concluded that the convergence of plasma and nanotechnology provided a suitable strategy that may lead to the required therapeutic outcomes in oncology research, and traditional methods remained improvable for many types of tumor entities.

A significant impact of different nanomaterials manifested with a variety of toxicities (including oxidative stress) that occurs in the aquatics was also presented in this Issue. Malhotra and colleagues in the review article "An Update Report on the Biosafety and Potential Toxicity of Fullerene-Based Nanomaterials toward Aquatic Animals" presented a lot of evidence that waterborne exposure to fullerene-based nanomaterials triggers toxicities at the cellular, organic, and molecular, as well as neurobehavioral levels. Analyzing numerous original studies, the authors explained that the effects of fullerene-based nanomaterials strongly depend on their chemical structure. Likewise, for the organic nanoparticles, the inorganic nanosized particles also induced numerous toxicities in aquatic species, as presented by d'Amora and collaborators. In their comprehensive review article entitled "Effects of metal oxide nanoparticles in zebrafish", they offered a plethora of data that the use of metallic oxide nanoparticles leads to the possible toxicity in zebrafish (during both adulthood and growth stages). Thus, the unavoidable human exposure to this kind of pollution may also have an adverse effect, emphasizing the role of oxidative stress.

Conflicts of Interest

The editors declare that they have no conflicts of interest regarding the publication of this special issue.

Acknowledgments

We would like to thank the authors of the published articles in this special issue. Their inspiring original research, as well as the insightful critical update in review articles, made a significant improvement in the knowledge of these rather current research topics. We also emphasize the reviewers' extremely professional attitude that allowed the authors to achieve the highest standards of the journal. We are particularly expressing our deep and sincere gratitude to guest editors Igor Jakovcevski, Miodrag Stojkovic, Sergey Bolevich, and Vladimir Jakovljevic for their excellent expert contribution at all stages of the published papers mentoring. Finally, we highly appreciate the effort of the journal editorial and management that accurately and competently supported the whole process and significantly improved the quality of this issue.

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