Mini Review
Volume 8:3, 2023

Journal of Nanosciences: Current Research

ISSN: 2572-0813 Open Access

Toxicological Risk Assessment of Emerging Nanomaterial

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Abstract

As the field of nanotechnology continues to advance, it brings with it a multitude of potential benefits across various industries, including electronics, medicine and energy. However, amidst the excitement surrounding nanotechnology's promises, there is a growing need to address equally important aspect nano toxicity. Nano toxicity refers to the potential adverse effects that nanomaterials may have on human health and the environment. Understanding and unraveling the dangers of nano toxicity is essential to ensure the safe and responsible development and application of nanotechnology. Nanomaterials possess distinctive properties due to their small size, typically ranging from 1 to 100 nanometers. These properties, such as increased surface area, altered chemical reactivity and unique electromagnetic behavior, make nanomaterials highly desirable for various applications. However, these same properties can also contribute to their potential toxicity. The potential risks associated with nano toxicity primarily revolve around human health. When nanomaterials are inhaled, ingested or come into contact with the skin, they can enter the body and interact with cells and tissues. Due to their small size, nanomaterials can penetrate barriers that larger particles cannot, allowing them to reach sensitive areas such as the lungs, cardiovascular system and even cross the blood-brain barrier.

Keywords: Nanomaterials • Nano toxicity • Nanoscale

Introduction

The environmental impact of nanomaterials is another area of concern. As nanomaterials are increasingly incorporated into consumer products and industrial processes, there is a risk of their release into the environment during manufacturing, use and disposal. Once released, these nanomaterials can enter ecosystems and nanotechnology, with its ability to manipulate and control matter at the nanoscale, holds great promise for numerous fields, including medicine, electronics and energy. However, alongside the advancements and applications of nanotechnology, there is a need to carefully consider theNano toxicity refers to the adverse effects that nanomaterials may have potential risks associated with nanomaterials. on human health and the environment. Understanding nano toxicity is crucial to ensure the safe and responsible development and use of nanotechnology. Several studies have shown that certain types of nanomaterials, such as carbon nanotubes and metal nanoparticles, can induce inflammation, oxidative stress and damage to cellular DNA. These effects can lead to various adverse health outcomes, including respiratory problems, cardiovascular disorders and even the development of cancer. Additionally, the potential for nanomaterials to accumulate in the body over time raises concerns about long-term exposure and chronic health effects. Nanomaterials exhibit distinct properties due to their small size, typically ranging from 1 to 100 nanometers. At this scale, materials can possess altered physical, chemical and biological properties compared to their bulk counterparts. These unique properties contribute to the potential risks associated with nanomaterials and their interaction with biological systems [1,2].

Literature Review

One of the primary concerns regarding nano toxicity is its impact on human health. When nanomaterials are inhaled, ingested or come into contact with the skin, they can enter the body and interact with cells and tissues. Due to their small size, nanomaterials can penetrate biological barriers, including the respiratory system and gastrointestinal tract, potentially leading to adverse effects. Numerous studies have highlighted the potential toxicity of certain nanomaterials, such as carbon nanotubes, metal nanoparticles and quantum dots [3]. These nanomaterials have been shown to induce inflammation, oxidative stress and cellular damage, which can lead to various health problems. Respiratory issues, cardiovascular disorders and even the development of cancer have been associated with exposure to certain nanomaterials. The potential for nanomaterials to accumulate in the body over time raises concerns about chronic exposure and long-term health effects. In addition to human health risks, the environmental impact of nanomaterials is an important consideration [4].

Discussion

As nanotechnology continues to expand, the release of nanomaterials into the environment during manufacturing, use and disposal is a significant concern. Once released, nanomaterials can interact with ecosystems and potentially harm aquatic and terrestrial organisms. Research has shown that certain nanomaterials can have adverse effects on the environment. They can accumulate in organisms, disrupt ecological balance and impact the reproductive capabilities of various species. Aquatic organisms, such as fish and invertebrates, are particularly vulnerable to the potential toxic effects of nanomaterials. Understanding and mitigating the environmental impact of nanomaterials is crucial for the sustainable development and responsible use of nanotechnology. Efforts are underway to unravel the complexities of nano toxicity and develop a comprehensive understanding of its mechanisms. Scientists and researchers are investigating how nanomaterials interact with biological systems, including their cellular uptake, distribution and potential toxicity pathways. By studying the physicochemical properties of nanomaterials and their interactions with living organisms, valuable insights are gained into the potential risks they pose [5,6].

Conclusion

Standardized testing methods and regulatory frameworks are being developed to assess the safety of nanomaterials. These approaches aim to identify potential hazards, evaluate exposure limits and establish guidelines for the safe handling and disposal of nanomaterials. Comprehensive toxicity testing is essential to evaluate the potential risks of nanomaterials and ensure

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Received: 02 May, 2023, Manuscript No. Jncr-23-108933; **Editor Assigned:** 04 May, 2023, PreQC No. P-108933; **Reviewed:** 16 May, 2023, QC No. Q-108933; **Revised:** 22 May, 2023, Manuscript No. R-108933; **Published:** 30 May, 2023, DOI: 10.37421/2572-0813.2023.8.173

their safe use in various applications. To mitigate the risks associated with nano toxicity, a proactive and multidisciplinary approach is necessary. Collaboration among scientists, policymakers and industry stakeholders is crucial to establish effective risk assessment strategies and guidelines for the responsible use of nanomaterials.

Acknowledgement

None.

Conflict of Interest

No potential conflict of interest was reported by the authors.

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How to cite this article: Wagr, Martin. "Toxicological Risk Assessment of Emerging Nanomaterial." *J Nanosci Curr Res* 8 (2023): 173.