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Reducing toxicity by designing bio-inspired Nanomaterials

Monica Neagu
University of Bucharest, Romania

Above and beyond the nanoparticles that arise in the environment, in nanomedicine, the toxicity displayed by nanomaterials is a major concern. While developing new nano-carriers and nano-drugs that have shown their medical applications, research has witnessed new areas of toxicity inflicted upon humans. Penetrating this domain, the search has begun for finding the best option to overcome the known toxicity of nanomaterials. In this view, a new domain has been recently raising, the area of bio-inspired nanomaterials. Nature has inspired nanomedicine to use materials that reproduce the complexity of biomolecules mimicking the functional characteristics. Resembling nature, various types of functional nanosystems are explored. Thus, the area is very broad, namely carbohydrates can be tailored to develop nano-sensors, then peptides and proteins can be designed in specific transporters of drugs through cells overcoming toxicity and drug-resistance. The most recent bio-inspired endeavor is designing entire synthetic viruses and bacteria that are the perfect drug and active biomolecules carriers. The main groups of biomolecules that can be developed in nanomaterials are peptides, these structures having multiple chemical binding capacities to be tailored in larger structures like proteins and/or other biological molecules. Moreover, as nature has planned, these biomolecules can respond to the biological milieu by physiologically altering its structure and function; this property suits very well their applications in nanomedicine. There are several clear applications of bio-inspired nanomaterials like reversing multi-drug resistance in cancer cells. In another medical application, they can act as vaccine delivery systems. Lipid-based particles, micelles, nanostructures of natural or synthetic polymers, and even lipid-polymer hybrid nanoparticles can significantly increase vaccines immunogenicity. These bio-inspired nanomaterials are still an open area that is to be explored in the permanent scientific quest to reduce toxicity while developing the best/efficient therapy accomplishment.

e: neagu.monica@gmail.com

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