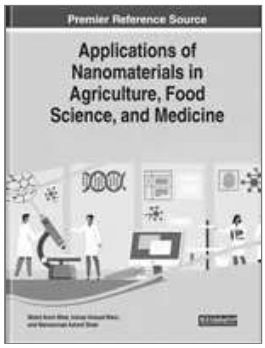

Nanotechnology as an Emerging Field in the Arena of Medicine

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Abstract

Nanotechnology as an emerging scientific field has enabled humanity to manipulate the environment at molecular and atomic level and has touched and even revolutionized all scientific fields due to its characteristic features. Medicine is one of the important fields that witnessed a nanotechnological revolution that guided medical scientists to device new approaches to study pathologies and explore genuine therapeutic tricks by exploring nanotechnology to operate on more specific molecular targets and to reduce the adverse risks and side effects imposed by the conventional approaches. By manipulating drugs and other materials, the fundamental properties and bioactivity of the materials can be altered at the nano scale. These tools can led to the different characteristics of drugs or agents such as a) modulation in solubility and blood pool retention time, b) controlled release over short or long durations, c) environmentally triggered controlled release or highly specific site-targeted deliver.

Chapter Preview

Top

Introduction

The field of nanotechnology is dedicated to research and technology advancement which enables the creation of useful materials, devices, and systems through the controlled manipulation of properties of matter on atomic and molecular levels. Jeevanandam, et al., (2018). From last two decades, the field of nanotechnology has progressed tremendously with hundreds and thousands of publications in this field. Nanotechnology is the interdisciplinary research programme involving scientists from many different fields, including physics, chemistry, engineering, and biology. Although, the word nanotechnology seems to be relatively new for us, but the nature has already set its foundation with the creation of life millions of years ago. The constructing and basic units of life are having unique properties determined by the size, folding and patterns at nanoscale. The size of nucleotide bases in deoxyribonucleic acid (DNA) range in the sub-nanometre scale, and the diameter of the double helix structure of DNA is in the nanometre range. Likewise, cell membranes which consist of lipids and proteins are beautifully designed by nature at nanoscale. (Abu-Salah, et al., 2010). Thus exploiting this property, nanomedicine can be considered to be an ultimate therapeutics to interact with cells having dimensions (microns) that allow them to interact efficiently with nanoparticles (10–200 nm). Thus the basic knowledge and understanding of biological processes on the nanoscale level can be a strong attempt for the development of successful nanomedicine. In essence, nanomedicine is the medical use of nano-sized particles, nanofiber and nanodevices to deliver drugs, heat, light or other substances to specific cells in the human body and for the detection and treatment of diseases or injuries within the targeted cells, thereby minimizing the damage to healthy cells in the body. Application and uses of nanotechnology in screening, diagnosis and treatment of diseases are collectively referred to as ‘Nanomedicine’. (Hu, Ye, et al. 2011)

The properties of nanomaterials are midway between molecular and bulk regimes. Whether nature or synthetic, nanoscale properties exist in all materials. Nevertheless, only synthetic materials are actually considered part of “nanoscience and engineering”, while the study of bio- nanoscale structures are often studied as a part of characterization without taking into considering biological properties. Due to the midway properties of nanomaterials, it becomes difficult to limit a material’s reach and confine its boundary by applying strict rules of definitions and solid numbers (e.g., bigger than atoms or small molecules, but smaller than 100 nm). More significantly, these nano-sized particles can display new and unique properties by virtue of which these can be explored for the design of new remedial benefits and diagnostics.