Advances in Nanoparticles-based Controlled Delivery of Natural Bio-actives

Controlled medication delivery of natural bio-actives has emerged as a promising research subject in recent years. The fundamental reason for this is that bioactives derived from natural sources have been identified as viable candidates for the prevention and treatment of a variety of disease presentations without the negative side effects associated with synthetic therapies. Natural bio-actives, on the other hand, could not be fully utilized because of limitations, such as poor solubility, low bioavailability, and poor stability, all of which hampered their therapeutic efficiency. As a result, scientists around the world are working to develop nanotechnology-based controlled delivery methods to address the challenges of developing safe and effective formulations of natural bioactives. Several successful attempts have been made in the recent past to exploit the potential of bioactives through nanotechnology in order to achieve various objectives such as increasing solubility and bioavailability, reducing toxicity, increasing shelf life, and broadening the spectrum of activity, thereby increasing their overall therapeutic value. In addition, different pieces of research have been conducted to address the commercial and regulatory problems. The goal of this special issue is to highlight current breakthroughs in nanoparticle-based regulated delivery of natural bioactives. Below is a brief summary of all of the accepted articles.

The paper reported by Hussein et al. has up-to-date information on the effects and functions of pomegranate juice and its bioactive components on the most widespread six cancer types [1]. Cancer is a complex illness worldwide with approximately 200 different forms. It is widely accepted that utilising natural polyphenolic anticancer foods, vegetables, and fruits, avoiding exposure to carcinogenic environments, quitting smoking, and other lifestyle changes are all effective ways to fight cancer. The current study summarises the most recent research on the effects and functions of pomegranate juice and its bioactive components on the six most common cancer types. Pomegranate includes polyphenolic chemicals, including ellagittannins and punicalagin, which have significant antioxidant properties and can scavenge free radicals and produce metal-chelates in biological tissues. Pomegranate's antioxidant and anti-inflammatory qualities appear to be the most important antimutagenic and antiproliferative capabilities for controlling gene expression, altering cellular processes, and restricting cancer's potential to metastasis, according to in vitro and in vivo research. Pomegranate components have been linked to the prevention and treatment of cancer, particularly colorectal and prostate cancer, in a small number of clinical investigations. It is still a clinical conundrum in cancer therapy to hit the proper target without causing adverse effects. Drug resistance and major adverse effects in important organs and noncancerous surrounding cells are frequently connected with expensive anticancer chemotherapies. Pomegranate-based phytoterapies appear to be an economical and cost-effective alternative to next-generation non-pharmacologic anticancer treatments with fewer side effects. To determine the long-term safety, efficacy, and dosing regimens for orally delivered pomegranate formulations, well-designed, randomised, double-blind, and multi-center trials are required.

Parashar et al. reviewed the role of green synthesized silver nanoparticles as a silver lining in antimicrobial resistance [2]. Antibiotic misuse has resulted in antimicrobial resistance (AMR) against commonly used drugs, which has become a major source of concern for scientists. However, because of their unique physico-chemical properties, green produced silver nanoparticles (AgNPs) have attracted more attention in the last decade for the development of innovative antimicrobial medicines. AgNPs, unlike standard antibiotics, work through numerous mechanisms, making them potential options to combat AMR. In multiple attempts, the green synthesis of AgNPs utilizing various medicinal plants has exhibited a larger spectrum of action against several bacteria. The paper examines scientific investigations that have revealed the beneficial role of plant extracts PHYTOCHEMICALS in the green synthesis of AgNPs, as well as their future prospects. Although the results of the research so far appear promising, a few factors such as the precise mechanism of action of AgNPs, their synergistic interaction with biomolecules, and industrial scalability must be further investigated before effective drug development using green synthesised AgNPs in healthcare systems against AMR can be established.

Kant et al. reviewed the different natural bioactive agents in the form of nanoformulations for wound healing potentials [3]. Wound healing is a biological phenomenon that involves a series of biochemical reactions that are primarily concerned with restoring the organ's cellular integrity. The market for wound-care products has grown significantly, surpassing fifteen billion dollars, as well as twelve billion dollars for wound scar treatment. Various bioactive chemicals have been demonstrated to have a variety of pharmacological effects, including wound healing activities. Because of its favourable nature of having few adverse effects, natural bioactive compounds have attracted a lot of interest in wound management. Curcumin, quercetin, lansone, resveratrol, aloe vera, astrapaloside, essential oils, growth factors, andrographolide, bilirubin, and other bioactive substances have demonstrated significant wound healing potential. Because of their poor aqueous solubility, rapid disintegration rate, and low bioavailability, most natural bioactive compounds have little clinical utility. In recent years, these issues have been solved by encapsulating them in nanoformulations. Bioactive agents' nanomaterials have distinct advantages, such as a high surface area to volume ratio and nanoscale size variations in physical and chemical characteristics. These nanoparticles also have a long-term regulated release, which appears to be highly useful for the lengthy wound healing process. The emergence of nanoparticles in wound healing applications has been the subject of numerous studies by international researchers.
Various natural bioactive substances in the form of nanoformulations have been reviewed for wound healing potentials in this review.

The paper contributed by Murthy et al. reviewed polymeric nanoparticles for transdermal delivery of polyphenols [4]. Polyphenols are a wide collection of naturally occurring secondary metabolites found in plants that have a variety of nutritional and health effects. They are completely harmless and abundant in the diet. Polyphenol research is currently focused on its mechanism and advantages to human health. However, due to their low solubility and bioavailability, distribution by traditional routes has proven difficult, and clinical applicability has been limited. Polymeric nanoparticles delivered topically and transdermally will be a novel therapeutic strategy for delivering polyphenols. We assessed the existing scientific literature and summarised the possible use of polymeric nanoparticles as a carrier for polyphenolic chemicals for administration via topical and transdermal routes for the treatment of skin malignancies like melanoma in this review.

Singh et al. have reviewed the compendium of Conventional and Targeted Drug Delivery Formulation Used for the Treatment and Management of the Wound Healing [5]. Wound healing is a complicated and dynamic process that involves the return of wounded tissue to its normal physiology and function. At the molecular level, different cytokines, inflammatory mediators, and growth factors are principally responsible for wound healing. Any intervention in the normal wound healing process causes more tissue damage, which causes wound healing to be delayed. The wound healing process was repaired and accelerated using a combination of natural and synthetic medications. However, traditional delivery carriers were ineffective, and as a result, nanocarriers are rising in popularity as they play an important role in medication delivery. Nanocarriers can expedite wound healing more effectively since they have their own application and benefits (enhanced bioavailability, site-specific targeting). The numerous processes that occur during the wound healing process were briefly reviewed in this review, with an emphasis on various natural, synthetic, and combination pharmacological therapy utilised for accelerating wound healing, as well as the significance of nanotechnology-based techniques in chronic wound healing.

The paper reported by Singh et al. presented a comprehensive review of medicinal herbs and novel formulations for the prevention of Alzheimer’s disease [6]. Alzheimer’s disease (AD) is one of the most common neurodegenerative illnesses among the world’s ageing population. Dementia affects around 46.8 million individuals worldwide, with Alzheimer’s disease being the leading cause of dementia in the elderly. The accumulation of β-amyloid (A) in the neocortex part of the brain is hypothesised to cause Alzheimer’s disease (AD). Modern therapy strategies focus on the disease’s underlying processes. Effective therapies necessitate improved absorption of herbal bioactives via new drug delivery methods. Herbal bioactives delivered via novel innovative drug delivery technologies have shown to be extremely effective in treating this condition. This review contains thorough information regarding the role of medicinal plants and their formulations in treating Alzheimer’s disease, with a focus on nanotechnology-based herbal formulations, making it extremely useful for researchers working in this field.

CONFLICT OF INTEREST

No conflict of interest regarding the publication of this Thematic Issue.

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