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Recent advances on therapeutic potentials of gold and silver nanobiomaterials for human viral diseases

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ABSTRACT

Viral diseases are prominent among the widely spread infections threatening human well-being. Real-life clinical successes of the few available therapeutics are challenged by pathogenic resistance and suboptimal delivery to target sites. Nanotechnology has aided the design of functionalised and non-functionalised Au and Ag nanobiomaterials through physical, chemical and biological (green synthesis) methods with improved antiviral efficacy and delivery. In this review, innovative designs as well as interesting antiviral activities of the nanotechnology-inclined biomaterials of Au and Ag, reported in the last 5 years were critically overviewed against several viral diseases affecting man. These include influenza, respiratory syncytial, adenovirus, severe acute respiratory syndromes (SARS), rotavirus, norovirus, measles, chikungunya, HIV, herpes simplex virus, dengue, polio, enterovirus and rift valley fever virus. Notably identified among the nanotechnologically designed promising antiviral agents include **AuNP-M2e peptide vaccine**, **AgNP of cinnamon bark extract** and **AgNP of oseltamivir** for influenza, **PVP coated AgNP** for RSV, **PVP-AgNPs** for SARS-CoV-2, **AuNRs** of a **peptide pregnancy-induced hypertension** and **AuNP nanocarriers** of **antigen** for MERS-CoV and SARS-CoV respectively. Others are **AgNPs of collagen and *Bacillus subtilis*** for rotavirus, **AgNPs labelled Ag30–SiO_2** for murine norovirus in water, **AuNPs** of ***Allium sativum*** and **AgNPs** of **ribavirin** for measles, **AgNPs of *Citrus limetta*** and ***Andrographis Paniculata*** for Chikungunya, **AuNPs** of **efavirenz** and **stavudine**, and **AgNPs-curcumin** for HIV, **NPAuG3-S8** for HSV, **AgNPs of *Moringa oleifera*** and ***Bruguiera cylindrica*** for dengue while **AgNPs** of **polyethyleneimine** and **siRNA** analogues displayed potency against enterovirus. The highlighted candidates are recommended for further translational studies towards antiviral therapeutic designs.

1. Introduction

Viruses are the smallest microbes proven to be of great threat to human well-being with no known cure for a high number of their taxonomical strains (García-Serradilla et al., 2019; Draz and Shafiee, 2018). They are responsible for most human pathogenic infections and are difficult to manage for health practitioners. Several viruses such as influenza, hepatitis, Ebola, Zika virus, human immunodeficiency virus (HIV), herpes simplex virus (HSV), Hepatitis C virus (HCV) and recently coronaviruses (CoVs) have been identified as a serious threat to humanity through disease outbreaks and pandemics (Akbarzadeh et al., 2018; Ellah et al., 2019). For instance, the coronavirus 2019 (COVID-19) pandemic overwhelmed the world healthcare and economic systems, infecting millions of people, with a higher mortality rate amongst the vulnerable. Governments and health bodies across the globe had to devise various effective strategies to prevent the spread of the virus, which remains a big struggle. Till this moment, scientific efforts are being made by researchers to find a vaccine and effective treatment options for the infection with limited success (Palmieri and Papi, 2020). Generally, despite the enormous efficacious potentials of some topical virucidal agents, toxicity, the resistance of the pathogens and suboptimal delivery of the agents to target sites contributively limit their real-life clinical

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