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What is Importance of Nanotechnology in Disinfection Applications: A Mini Review

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Abstract

Disinfection practices is the most important step in controlling infectious diseases. Numerous types of disinfectants are available with different properties. Antimicrobial resistance, and allergic diseases are common effect for unconscious disinfectant using. There is increased demand for improved disinfection methods due to microorganisms resistant to multiple antimicrobial agents. Nanotechnology has emerged up as a new promising technology for synthesis of nanomaterials, particles in the nanometer size, which exhibit antimicrobial effects owing to their high surface-area–to-volume ratio and unique chemical and physical properties. The bactericidal effects of various metallic nanoparticles including copper, titanium, zinc and silver, have been well documented. Silver has been known to have a disinfecting effect as well as applica¬tions in traditional medicine and culinary items. Silver nanoparticles showed great antibacterial effects on microorganisms.

Keywords: Disinfectant; Nanotechnology; Silver

Introduction

Infectious diseases which has existed since the beginning of human history; despite advances in diagnosis and treatment, today it is one of the first leading diseases that threaten human life all over the world. Environmental contamination plays an important role in the transmission of infections, especially healthcare-associated infections. Disinfection practices is the most important step in controlling infectious diseases [1]. Numerous types of disinfectants are available with different properties; but the proper disinfectant must be carefully selected for any specific application to obtain the desired antimicrobial effect. Using various physical and chemical methods, it is possible to kill or inactivate to pathogenic microorganisms with these applications [2,3]. As a results of unconscious use of disinfectants, microbial resistance, allergic diseases, incompatibility with applied surface have been emerged. There is increased demand for improved disinfection methods due to microorganisms resistant to multiple antimicrobial agents [4]. In parallel with technological developments, nanotechnology, particularly electronics, agriculture, biology, mechanics, medicine, biotechnology, pharmaceutical and chemical fields has found an important application area. Today, this technology has beenthe solution to many problems in the disinfection applications [5]. During the past few decades, nanotechnology has emerged up as a new promising technology for synthesis of nanomaterials, particles in the nanometer size, which exhibit antimicrobial effects owing to their high surface-area–to-volume ratio and unique chemical and physical properties.

Nanotechnology originates from the Greek word meaning “dwarf”. A nanometre is one billionth (10-9) of a metre, which is tiny, only the length of ten hydrogen atoms, or about one hundred thousandth of the width of a hair. Nano-products in the size of 0.1nm and 100nm are in the form of supra-molecular structures, complexes or compounds [5,6]. These products are to be seen the value of the measurement volume is small, but functional liters, kilograms or meters, as measured by the carrying product feature. Measurement unit values of these products are too small to be seen with the naked eye, although functionally liters, kilograms or meters, as measured by the carrying product feature [6].

Many of nano products which are developed slogan with permanent antimicrobial solution has also a growing user profile in all over the world. Especially, in the product panels which used metal ions proven antimicrobial efficacy such as silver, toxic effects are kept at the lowest level. The bactericidal effects of various me¬tallic nano particles including copper, titanium, zinc and silver, have been well documented [7,8]. Silver has been known to have a disinfecting effect as well as applica¬tions in traditional medicine and culinary items. As early as 1000B.C. (Before Christ), silver was used to make water potable. High

antimicrobial efficacy of ionic sil¬ver (Ag+) against a broad spectrum of Gram positive and Gram negative bacteria as well as fungi in combina¬tion of low toxicity against human tissue has been led to the wide application of elemental silver or silver com¬pounds in medicine [9,10]. Hence, silver nanoparticle (Ag NPs) is a good candidate as an alternative for formulation of a new generation of antibacterial agents used in biologi¬cal, medical, and pharmaceutical applications [11].

Nano-silver is increasingly used in consumer products from washing machines and refrigerators to devices marketed for the disinfection of drinking water or recreational water [12,13]. The effect of products on microorganisms; the structure of the cell protein degradation, disruption of cell membrane functions, compound with a variety of nucleic acid molecules, creating a neutralized form. The activity of all known disinfectants may vary depend on physical factors such as applied environmental temperature, pH, osmotic pressure, surface tension. At the same time, concentration, application time, place and applied shape is also important to this activity [14]. In the applications of nano disinfection, nanometer-sized nanoparticles in the product that are larger than their lethal effect on micro-organisms interact with a very short period of time. In the studies of products effectiveness were shown long term effects and killing effect (99%) for pathogenic bacteria, viruses, mold [15-17]. Due to the mechanical effects of the products are not shown microbial resistance so far. In order to lasting impact on applied surfaces for months, including in many medical devices, cosmetics, food, agriculture seen as a significant problem areas prevents the formation of biofilm. Nano-products are subsistence in many applied surfaces, non-toxic, effect a wide range of micro-organisms, effective for a broad range microorganism group, not generate waste product [11,17-21].

Silver nano particles showed great antibacterial effects on microorganisms. Therefore, with development of multidrug-resistant strains of bacteria, Ag NPs could be good alternatives for cleaning and dis¬infection of equipment and surfaces. With these features, they provide significant contributions to human and environmental health. In addition to these advantages, they are highly concentrate and lower cost product.

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