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Short Communication

The ability of silver nanoparticles to kill bacteria, and the effects of industrial chemicals on biological indicators in water, sediment, and soil

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Abstract

Using a conventional laboratory toxicity test, the lethal toxic effects of industrial detergent (Neatex) and corrosion inhibitor (Norust CR 486) that are often discharged into the Nigerian environment were investigated.

Using the Organization for Economic Cooperation and Development (OECD) # 203, 218 and 207 procedures, bio indicators (fish, shrimp, and earthworms) were subjected to various concentrations of the test substances. Both compounds were modestly harmful to organisms according to the water, sediment, and soil ratings, but the corrosion inhibitor was more toxic than the industrial detergent based on the predicted 4, 10, and 14-day lethal concentrations (LC50). Between organisms exposed to the test compounds in the three mediums and the control groups, there was differentiable toxicity at (p 0.05).

Because most chemicals released into the environment bind to soil and sediment particles and can harm organisms in the soils, sediment, and overlying waters, the observed sensitivity of the test organisms to both chemicals in the different media provides a basis for routine checks on chemicals discharged into the Niger Delta waters.

Nanotechnology is anticipated to provide new opportunities for atomic-scale disease treatment and prevention customization of materials. Metallic nanoparticles, which display higher chemical activity as a result of their huge surface to volume ratios and crystallographic surface structure, are among the most promising nanomaterial with antibacterial capabilities. In this study, we carried out batch tests to evaluate the effectiveness of silver nanoparticles made by the citrate reduction process as antibacterial agents. Comparing the zone of inhibition, time-dependent antibacterial activity, and Escherichia coli growth rate of silver nanoparticles with $AgNO_3$'s antimicrobial activity. When E. coli was exposed to silver nanoparticles at concentrations of 30 g m-1, 100% of the growth was reduced, but the effect of $AgNO_3$ was significantly less pronounced at this concentration.

By employing various concentrations of $AgNO_3$ and silver nanoparticles, the zone of inhibition test was also carried out to determine the degree of inhibition. It was discovered that a concentration of 10 g ml-1 could stop bacterial growth and produce an $AgNO_3$ and Ag nanoparticle zone of 0.8 cm and 1.7 cm, respectively. $AgNO_3$ is not as effective a candidate for antibacterial action as Ag nanoparticles.

Keywords: lethal toxicity, fish, shrimp, earthworm, industrial chemical, surfactant Antimicrobial potential, silver nanoparticles, Escherichia coli.

INTRODUCTION

Due to their greatly enhanced and new physical, chemical, and biological characteristics, phenomena, and functioning during the past several decades, inorganic nanoparticles have attracted a lot of attention. Due to their potential for attaining specialized processes and selectivity, particularly in biological and pharmaceutical applications, Nano phasic and nanostructured materials are gaining a lot of interest (Pal et al., 2007). Globally, there is growing environmental concern around the usage of dangerous chemicals. There are numerous such chemicals that pollute the environment, and the harm they do depends on the creatures they impact, how long they remain in the ecosystem, and how they are exposed to them (Willis KJ et al., 2003). Surfactants, which are cleaning agents used in both industrial and home settings, are heavily discharged into streams and onto land. They might cause eutrophication, foaming, and surfactant toxicity in fish and invertebrates, among other environmental issues in the ecosystem.

Recent research has shown that carefully designed metal oxide nanoparticles have strong antibacterial action, and antimicrobial compositions including nanoparticles may be useful bactericidal agents. Since ancient times, silver has been the inorganic antibacterial agent that has been used the most frequently to combat infections and prevent spoiling. There has been much research into the antibacterial and antiviral properties of silver, silver ions, and silver compounds (Oloffs et al., 1994). However, silver is harmless to human cells at small amounts.

Chemical ecological assessment is crucial for environmental protection. In order for a product to be recognized on a global scale nowadays, it must not only function well but also adhere to strict environmental standards. According to international legislation, a novel chemical must be registered and its environmental performance must be disclosed before it may be utilized. Typically, ecological risk analyses are carried out to determine the level of hazardous waste contamination in the aquatic and terrestrial biota (George A et al., 2000).

Silver's nontoxicity in routine usage has been confirmed by epidemiological history. Its bactericidal activity is likely due to catalytic oxidation of metallic silver and an interaction with the dissolved monovalent silver ion (Oka et al., 1994). The metal hits a wide range of targets in the organisms, making it hard for microbes to build resistance to it as they do against traditional and narrow-target antibiotics. Instead, they would need to undergo a variety of changes at the same time to defend themselves (Sharma VK et al., 2009).

However, due to many factors, including the conflicting effects of salts and the antibacterial process of continual release of adequate concentration of silver ion from the metal form, Ag+ ions or salts have very limited value as antimicrobial agents. However, these sorts of restrictions may be removed using silver nano particles (Tovel PWA et al., 1975).

CONCLUSION

Surfactants like linear alkylbenzene are included in the majority of prepared goods like detergents and corrosion inhibitors. (LAS) sulphonates numerous writers have claimed that Anionic surfactants (LAS) damage the gills damage chemoreceptor organs, the epithelium, and skin and the pharyngeal wall. Fish are reportedly acutely harmful to anionic surfactants and other aquatic creatures, with concentrations ranging from 40 and 0.4 mg/l. The degradation of LAS in Rivers and soils might be harmful to the creatures that live there these surroundings. According to reports from 2004, there is a link between the usage, storage, transportation, and disposal of chemicals into the environment increasing issue that jeopardizes the wellbeing of the environment and people.

This study's objective was to calculate the short-term two frequently used compounds' toxicity, industrial Cleanex detergent and Norust CR corrosion inhibitor (486) to shrimp (Desmoscaris); tilapia (Tilapia guineensis); earthworms, and Tripsinosa (Aporrectodea longa). These depending on the organisms' availability, Sensitivity and simplicity of upkeep in laboratory the circumstances and eating by several bigger animals.

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