International Research Journal of Microbiology Vol. 11(6) pp. 1-3, November, 2022
Available online http://www.interesjournals.org/IRJM

Mini Review

Transition Metal Acid's Antimicrobial Properties on Material Surfaces, Moo3 Limits Microbial Development, and a Dramatic Increase in Multi-Resistant Microorganisms is Self-Inflicted: There are Solutions that are Effective and Simple

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Received: 01-Nov-2022, Manuscript No. IRJM-22-81950; **Editor assigned:** 03-Nov-2022, PreQC No. IRJM-22-81950 (PQ); **Reviewed:** 17-Nov-2022, QCNo.IRJM-22-81950; **Revised:** 22-Nov-2022, Manuscript No. IRJM-22-81950 (R); **Published:** 29-Nov-2022, DOI: 10.14303/2141-5463.2022.22

Abstract

The growth, proliferation, and transfer of harmful organisms are optimal in clinical settings. Hospital surfaces, including furniture, ECG lead wires and other cables, infusion pump push buttons, ventilation machine control knobs, textiles, and implantable biomaterials like central venous catheters, urologic catheters, and endotracheal tubes, are becoming more and more frequently contaminated with multi resistant microorganisms. The nurses' hands spread these bacteria throughout the hospital, posing a major and maybe fatal risk. Nosocomial infections affect 1.8 million patients in Europe every year, and they're responsible for about 180,000 fatalities. According to the Centers for Disease Control (CDC), 2 million Americans are thought to have an infection associated to hospitals each year (Tanwar et al., 2014).

Infectious materials and equipment that have been colonised by microorganisms frequently spread serious infectious problems of patients in hospital settings (nosocomial infections). Consumption of the antimicrobial agent and newly emerging multidrug-resistant microorganisms are just a couple of the problems that current methods of producing material surfaces with an antimicrobial activity face. Therefore, surfaces made of materials that permanently inhibit the growth of bacteria that are resistant to them are preferred. This article discusses transition metal acids, such as molybdic acid (H2MoO4), which is based on molybdenum trioxide, having incredibly effective antibacterial characteristics (MoO3). Six hours after being contaminated with infectious agents, surfaces of various materials (such as polymers and metals) treated with MoO3 particles or sol-gel generated coatings were virtually free of microorganisms. The creation of an acidic surface, which hinders cell growth and proliferation, is the basis for the antibacterial activity (Dramé et al., 2020). An inventive strategy to stop the spread of microbes in healthcare facilities and public settings is the application of transition metal acids as antibacterial surface agents.

INTRODUCTION

Millions of deaths occur each year as a result of the global increase in multi-resistant bacteria. According to a recent study, bacterial infections that are resistant to antibiotics are responsible for 4.95 million fatalities. Without resistance, 1.27 million fatalities caused by bacterial infections would have been avoidable. Bacterial resistance was identified in the "Report on Antibiotic Resistance" as one of the leading causes of death globally and as requiring immediate, creative, and ambitious action. Therefore, preventing nosocomial infections from multiresistant bacteria is given a lot of attention. However, determining the causes of the emergence of multiple drug-resistant bacteria is an important first step (MDR). In addition to causing at least 175,000 fatalities annually in industrialised nations, health care associated infections (also known as nosocomial infections or NI) are the fourth most common cause of disease and the most frequent complication affecting hospitalised patients (Dadgostar 2019). According to reports from the US, NI is responsible for 90,000 avoidable deaths and 2 million infections per year. In addition, the transmission of infections and the associated biofilm development have become more and more significant in industrial settings (such as power plant cooling towers), water treatment and sanitation, food packaging, and public settings (e.g. public transportation). Emerging antibiotic-resistant microbes, such as methicillin-resistant Staphylococcus aureus (MRSA), vancomycin-resistant Enterococcus species (VRE), and Gram-negative microorganisms producing an extended spectrum of beta-lactamases (ESBL), are encountered along with an increasing number of extremely vulnerable patients (Rodríguez et al., 2021). The problem is made worse by the fact that, due to the high expenses of research and clinical testing, as well as regulatory issues, there won't be many new antibiotics being developed in the future to counteract the rising resistance (Reygaert 2018). This trend, which is present in the USA, Japan, and especially in Europe, may be viewed as dramatic in light of rising antibiotic resistance. Without a doubt, the primary objective in the prevention of NI continues to be barrier precautions such careful hygiene procedures and hand washing (Angulo et al., 2004). The surfaces of the inanimate environment, such as tools, cables, switches, accessories, doorknobs, bed linens, blankets, and sanitary installations, have been noted to act as a reservoir for multi-resistant pathogens and to facilitate infection when combined with invasive devices that bypass the body's natural lines of defense (Behr et al., 1994). The concept of prevention cannot be limited to hand washing or antimicrobial biomaterials due to the growing body of evidence linking the occurrence of NI to the transfer from contaminated surfaces. In sensitive locations, clean surfaces close to patients take precedence. Therefore, successful methods to lower the number of NI caused by illness transmission through inanimate objects free of microorganisms will improve societal health. Preventive or biocidal methods are now used to reduce microbial contamination on inanimate surfaces (Barrette et al., 1989). The first category uses an anti-adhesive layer to stop infectious agents from sticking to the surface. These include coatings made of amphiphilic polymer and poly (ethylene glycol), diamond-like carbon, self-cleaning surfaces, and Lotus effect surfaces (Ayres et al., 1993). Even inorganic antimicrobials were no match for the resistance that bacteria acquired. The cytotoxicity of several known antimicrobials, such as copper and silver ions, has been shown in mammalian cells, which restricts their use in biomedical devices and healthcare settings (Cozens et al., 1983). Not to mention, these materials frequently are not cost-effective. Therefore, it appears vital to create a new materials idea to address issues with current technologies (Gilbert et al., 1990).

The sol-gel approach may be a practical way to produce coatings with an antibacterial effect. A sol is a mixture of liquid and tiny solid particles. As a result, the precursors are composed of metallic or metalloid components that are encircled by a number of ligands. The formation of a three-dimensional network involves hydrolysis and condensation. This alters the sol's viscosity and causes it to shift from a sol to a gel and then to a solid, which is often an oxide ceramic. The sol-gel process is frequently used to create thin layers of various materials for uses in optics, electrochromics, photocatalysis, and antibacterial applications. Silver particles scattered in the coating so closely correlate with the antibacterial effect of conventional systems. As a result, the antibacterial action is transient and significantly correlated with the silver content.

CONCLUSIONS

On a variety of material surfaces, which were changed with transition metal oxides that can produce hydronium ions when in contact with water, we proposed a revolutionary materials concept to permanently inhibit the growth of infectious pathogens (bacteria). We were able to confirm that MoO3 had extremely effective antibacterial action against dangerous pathogenic pathogens like S. aureus and P. aeruginosa. Within 6 hours of being incubated with an infectious solution, polymer (PU) and metal (Ti) surfaces treated with MoO3 particles or sol-gel based coatings were almost bacteria-free. The MoO3 modified samples are not cytotoxic, as we could demonstrate. The surface acidity of transition metal acid MoO3 and the subsequent intermediate production of molybdic acid are connected to their antibacterial action. The surface acidity of transition metal acid MoO3 and the subsequent intermediate production of molybdic acid are connected to their antibacterial action. Since the antimicrobial active agents can be added using extrusion or other normal processing methods, our created materials idea can be applied to nearly any material surface. Wherever there is public interaction, materials having an antimicrobial coating are crucial to reducing the transfer and spread of infectious organisms. Therefore, it may be crucial to modify the surfaces of materials used in public transit and other high-traffic areas using antibacterial MoO3. In healthcare settings, where transmission of infectious agents can cause serious infections in already vulnerable patients, the decline of nosocomial pathogens like S. aureus and P. aeruginosa is crucial. The notion of MoO3-based antimicrobial materials that we have developed is crucial for reducing the risk of healthcare-associated infections, which are currently one of the main causes of disease. In order to reduce the spread of infectious pathogens in public settings, it is therefore generally of importance to modify material surfaces with antimicrobial active transition metal acid. The choice of multi-resistant infections, however, has a significant negative impact on specific patients. Contrarily, there is mounting evidence that the widespread use of disinfectants is to blame. Disinfectants, like antibiotics, must be absorbed into the metabolism of living things in order to be effective microorganisms. This is inextricably linked to the transmission of resistance plasmids, such as the stimulation of efflux pumps, which induces resistance. In the international literature, there are 7880 publications (PUBMed Jan 2022) that detail how bacteria are resistant to disinfectants; 649 publications describe how bacteria are also resistant to antibiotics; and 10 819 publications that discuss the toxicity of disinfectants. Additionally, the method is effective against microbes incorporated into biofilms! A biofilm's microbial inhabitants are hibernating and do not consume anything from the environment. As a result, no technology focused on incorporating an antibacterial chemical into bacterial metabolism will work against microorganisms embedded in a biofilm. Once more, technologies that eliminate microorganisms from the outside also eliminate those in a biofilm, a valuable asset. However, since oxygen radicals cannot penetrate the biofilm, technologies based solely on them are likewise insufficiently active. In the case of titanium oxide, this has been verified.

REFERENCES

1. Tanwar J, Das S, Fatima Z, Hameed S (2014). Multidrug resistance: an emerging crisis. Interdiscip Perspect Infect Dis.
2. Dramé O, Leclair D, Parmley EJ, Deckert A, Ouattara B, et al (2020). Antimicrobial Resistance of Campylobacter in Broiler Chicken Along the Food Chain in Canada. Foodborne Pathog Dis. 17: 512-520.
3. Dadgostar P (2019). Antimicrobial Resistance: Implications and Costs. Infect Drug Resist. 12: 3903-3910.
4. Rodríguez-Baño J, Rossolini GM, Schultsz C, Tacconelli E, Murthy S, et al (2021). Key considerations on the potential impacts of the COVID-19 pandemic on antimicrobial resistance research and surveillance. Trans R Soc Trop Med Hyg. 115: 1122-1129.
5. Reygaert WC (2018). An overview of the antimicrobial resistance mechanisms of bacteria. AIMS Microbiol. 4: 482-501.
6. Angulo FJ, Baker NL, Olsen SJ, Anderson A, Barrett TJ (2004). Antimicrobial use in agriculture: controlling the transfer of antimicrobial resistance to humans. Seminars in Pediatric Infectious Diseases. 15: 78-85.
7. Behr H, Reverdy M E, Mabilat C, Freney J, Fleurette J (1994). Relationship between the level of minimal inhibitory concentrations of five antiseptics and the presence of qacA gene in Staphylococcus aureus. Pathol Biol. 42: 438-444.
8. Barrette WC, Hannum DM, Wheeler WD, Hurst JK (1989). General mechanism for the bacterial toxicity of hypochlorous acid: abolition of ATP production. Biochemistry. 28: 9172-9178.
9. Ayres H, Furr JR, Russell AD (1993). A rapid method of evaluating permeabilizing activity against Pseudomonas aeruginosa. Lett Appl Microbiol. 17: 149-15.
10. Cozens RM, Brown MRW (1983). Effect of nutrient depletion on the sensitivity of Pseudomonas cepacia to antimicrobial agents. J Pharm Sci. 72:1363-1365.
11. Gilbert P, Collier PJ, Brown MRW (1990). Influence of growth rate on susceptibility to antimicrobial agents: biofilms, cell cycle, dormancy and stringent response. Antimicrob Agents Chemother. 34:1865-1868.