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Mini Review

Occurrence of Antibiotics Residues in the Marine Environment

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Abstract

The presence of residues of synthetic antibiotics in water bodies has been reported and documented by several scientific papers around the world, and the oceans are not alien to their presence, these pollutants enter into these environments due to their wide use in productive systems and in the human health care, many of them are highly stable, so their antimicrobial potential continues to impact the environment that hosts them, causing problems of bacterial resistance mainly among their main reported effects, however their carcinogenic and mutagenic potential of some of these compounds has been demonstrated, so, we will address their presence in marine environments, mainly due to the release of wastewater directly into these ecosystems.

Keywords: Antibiotic resistance; Water pollution; Wastewater treatment

Introduction

Aquatic ecosystems are of global importance to maintain high levels of biodiversity, ecosystem services and the livelihoods that depend on them [1]. Particularly, oceans influence the health and well-being of the world population, but coastal and marine ecosystems are being impacted by anthropogenic activities, significantly affecting hydrobiological resources [2]. A large number of studies have shown that the use of antibiotics has accelerated the appearance of bacterial resistance in the aquatic environment, which reduces the therapeutic effect of this compounds [3]. A great variety of pharmaceutical products has been detected in marine and freshwater organisms, sediments and waters, with involuntary effects in non-target organisms [4].

On the other hand, antibiotic residues sulfamethoxazole and trimethoprim have been reported in marine and estuarine environments at concentrations of up to 765-870ngL^{-1} respectively [4]. Human and veterinary pharmaceuticals, including antibiotics, anthelmintics, anti-inflammatories and beta-blockers, have also been reported in the marine environment in the South Korean Sea with average concentrations of up to 533ngL^{-1} in the coastal zone and in the fishing farm zone 300ngL^{-1} [5]. Likewise, antibiotic resistance is worsening the conditions of environmental behaviors and migration patterns of antibiotic resistance genes (ARG) have aroused considerable interest [6]. Understanding the long-term transport of pollution with ARG is crucial. Among all the ARGs identified so far, the sul genes are the most commonly observed [7].

Antimicrobial resistance in bacterial pathogens is a challenge that is associated with high morbidity and mortality. Patterns of multidrug resistance in Gram positive and negative bacteria are difficult to treat and may not be treatable with conventional antibiotics [8]. However, wastewater treatment plants (WWTP) contain various antibiotic resistance genes and are therefore considered a major route for the dissemination of these genes in environments. However, comprehensive assessments of dynamic ARGs during the wastewater treatment process lack comprehensive research on a broad spectrum of ARGs [9].

Sources of Antibiotics

Antibiotics are used intensively in livestock, aquaculture and in the treatment of human diseases [10]. Many pharmaceutical compounds are not completely metabolized by the human body, nor completely eliminated by the wastewater treatment systems, before their release to the environment and later reach the oceans [4]. However, the presence of tetracycline, norfloxacin, azithromycin, anhydrous erythromycin, cephalexin and amoxicillin has been reported in sewage treatment plants (WWTP) and in water and sediments of the Persian Gulf off the coast of Bushehr, Iran. The concentration of antibiotics in the effluent and effluent of the septic tank (the wastewater treatment plant of the hospital), activated sludge (the WWTP of the hospital) and the stabilization pond (municipal WWTP) ranged between 7.89 and 149.63, 13.49-198.47, 6.55-16.37 average: 533ngL^{-1} respectively [11].

Wastewater is among the most important reservoirs of antibiotic resistance in urban environments [12]. The abundance of carbon and other nutrient sources, a variety of possible electron acceptors such as oxygen or nitrate, the presence of particles on which bacte-

ria can adsorb, or a fairly stable pH and temperature are examples of conditions that favor remarkable diversity of microorganisms in this peculiar habitat [13]. The wastewater microbiome brings together bacteria of environmental, human and animal origin, many of which harbor antibiotic resistance genes [14]. Although many factors contribute, mainly in a complex interaction, to shaping this microbiome, the effect of specific potential selective pressures such as antimicrobial residues or metals is supposed to determine the fate of the antibiotic resistant bacteria (ARB) and ARG during the sewage treatment [15].

Presence of Antibiotics in Marine Flora and Fauna

Has been reported the influence of the level of tides and vegetation and mangrove on antibiotic residues belonging to families of sulfonamides, fluoroquinolones, tetracyclines and chloramphenicol. Antibiotic levels varied from 0.15 to 198 average: 533ngL^{-1} in water and 0.08 to 849μgkg^{-1} in sediment in the mangrove area of Gaoqiao, China [16]. Currently, the bioaccumulation and tissue distribution of antibiotics such as sulfonamide, trimethoprim and fluoroquinolones has been reported, while macrolides accumulate in the livers, influencing the toxicokinetic processes of marine fish [17].

Perspective to the Future

The marine ecosystem is made up of microorganisms, plants, invertebrates and vertebrates that are a rich source of various antimicrobial products, which are structurally unique and belong to a known class of macromolecules such as peptides, terpenes, alkaloids and proteins etc. [18]. The marine biosphere offers a wide range of invaluable and unique compounds that have diverse biological properties, including antitumor, anticancer, antimicrobial, antithrombotic, anti-inflammatory, etc. A large number of natural products originate directly from marine animals such as sponges, cnidarians, and molluscs, while some arise from microbes such as bacteria or fungi that are linked to other organisms or live in marine sediments [19].

Conclusion

The presence of antibiotics in the marine environment is a potential threat to marine fauna and flora, since they have the capacity to accumulate in tissues, influencing toxicokinetic processes. On the other hand, the world public health is directly affected already, these drugs, produce bacterial resistance by the appearance of diseases that for its treatment is necessary the consumption of a high amount of antibiotic.

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