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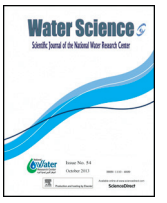

Research Article

Antibiotics resistance phenomenon and virulence ability in bacteria from water environment

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Abstract

This study aims to determine the impact of five main drains as sources of antibiotics resistant bacteria in River Nile at Rosetta branch, and to generate a baseline data on their virulence ability. Out of 212 bacterial isolates, 39.2% and 60.8% were recovered from drains and Rosetta branch, respectively. Susceptibility of bacteria to different antibiotics showed multiple antibiotics resistances (MAR) for the majority of isolates. Meanwhile, sensitivity was mostly directed to ofloxacin and norfloxacin antibiotics. Calculated MAR index values (>0.25) classified area of study as potentially health risk environment. Testing virulence ability of bacteria from drains showed positive results (65%). Contrastively, virulent strains in Rosetta branch were mostly lacking in this study. Concluding remarks justify the strong correlation (r = +0.82) between MAR and virulence of bacteria in polluted aquatic ecosystems, and highlight the potential of drains as reactors for their amplification and dissemination. The study suggests regular monitoring for antibiotics resistance in native bacteria of River Nile, prohibition of unregulated use of antibiotics, and proper management for wastes disposal.

Keywords: Water pollution; Bacteria; Antibiotics resistance; Virulence; Drainage water; Rosetta branch

1. Introduction

Microbial pollution is considered one of the most important factors governing water quality. The presence and level of pathogenic bacteria and viruses in water can have a profound impact on the lives of people around the world. Pathogen-contaminated water resources can impact human health through drinking water, agricultural produce, and

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even body contact. Symptoms of waterborne diseases may include gastrointestinal disorders such as severe diarrhea, nausea, vomiting and possibly jaundice as well as associated skin inflammations, respiratory and urinary tract infections. Bearing in mind that, not all people will be affected to the same extent; young children, immune compromised patients and the elderly are usually more susceptible (Pillai and Rambo, 2014).

The problem of microbial water pollution may be further complicated when coupled with the spread of antibiotic-resistant bacteria (Qiang et al., 2006; Novo et al., 2013). Although antibiotics and antimicrobials have revolutionized the treatment of infectious diseases since the golden age of penicillin production in 1941, yet rapid and increasing development of antibiotics resistance has reached a critical point. Bacteria have adapted defenses against these antibiotics, even as we develop new ones. Such problem is not confined only to clinical isolates but also extends to native isolates from aquatic environment, particularly polluted ones (Kümmerer, 2009). Concerns regarding potential threats of such resistant strains to human's health and wild life grew fatal (Wright, 2010). The dogma is that increasing antibiotics resistance is a consequence of extensive use and abuse of antibiotics in medication, veterinary, agriculture and aquaculture. Antibiotics are added to the environment at a rate of over a million pounds almost weekly. Globally, several studies have reported the presence of this phenomenon in all types of water including mineral water, drinking water, rivers, lakes, groundwater and wastewater (Messi et al., 2005; Oyetayo et al., 2007; Emmanuel et al., 2011; Mulamattathil et al., 2014). Threatens to our abilities to treat common infectious diseases, increased mortalities, and costs of remedy are by all means a matter of concern (Lupan et al., 2017).

Virulence is by definition "the power of microorganism to produce disease". It is merely associated with the capacity of the organism to attach and colonize at the site of infection, with subsequent interference with the host defense, and finally promoting damage to the host cells (Pasquaii et al., 2004; Galal et al., 2013). Actually, natural bacterial flora in well protected water resources, are not a subject of this matter. However, when get exposed to wastes discharge from medical health care facilities like hospitals, pharmaceutical plants, and/or sewage, several mechanisms evolve in these bacteria which engage them with antibiotics resistance and sometimes virulence abilities. Once the target genes are acquired, they could be inherited by daughter cells following cell division. Furthermore, under specific environmental conditions they can be disseminated to similar or dissimilar species through conjugation, transduction and transformation (Tenover, 2006; Alexander et al., 2011).

River Nile is the main water resource in Egypt. It services the country's demands for drinking water as well as both industrial and agricultural activities. River Nile travels along Egypt for about 950 km. it starts from downstream High Aswan Dam to upstream Delta Barrage, where it divides into two branches. The western branch is Rosetta branch (239 km in long) and the eastern branch is Damietta branch, (about 242 km long). Each of which runs separately, up to the Mediterranean Sea (Zaghloul and Elwan, 2011).

Rosetta branch has been selected for this study as being the main freshwater stream in Delta region as well as the source of potable water for six governorates namely: Giza, Menofiya, Gharbiya, Beheira, Kafr El-Sheikh and Alexandria. It has an average width of 180 m and depth between 2 to 4 m. It ends at Edfina Barrage, releasing excess water to the Mediterranean Sea. Unfortunately, the branch water quality is threatened by several point and non-point sources of pollution, the most important of which includes: El-Rahawy drain (400,000 $m^3\ day^{-1}$), Kafr El-Zayat industrial area (factories of super phosphate, sulfur compounds, oil, soap and pesticides) as well as several agricultural drains (El-Gammal and El-Shazely, 2008).

In view of aforementioned challenges, this study aims to highlight the potential hazards of drainage water discharge on River Nile at Rosetta branch concerning the prevalence of antibiotics resistance phenomenon and the possible associated virulence among isolated bacterial flora. Health hazards encountered with this problem will be also discussed.

2. Materials and methods

2.1. Study area and sampling procedure

The area covered in this study was chosen to represent two major water sectors in Egypt; River Nile and drainage water. It extended about 120 km in the River Nile at Rosetta branch. The branch was subdivided into five reaches based on locations of known waste inputs. Totally fifteen sites were chosen, three from each reach: five at drain outfalls (El-Rahway, Sabal, El-Tahreer, Zawiet El-Bahr and Tala) and ten sites in Rosetta branch (five upstream and five downstream those drains outfalls). These are mixed drains from sewage, agricultural and industrial wastes (Fig. 1).

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