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New Records of Pathogenic Bacteria from Urban Rivers in Argentina

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ABSTRACT

Aquatic environments associated with human settlements are mostly deteriorated by untreated or poorly treated discharges. Buenos Aires city and surroundings constitutes one of the largest urbanizations of the world. High levels of pollution have been detected for its related watercourses, showing the occurrence of a diversity of pathogenic bacteria in surface waters as well in biological members of the ecosystem. In the present paper the finding of new records for the area is reported and discussed. *Yersinia enterocolitica* and two subspecies of *Klebsiella pneumoniae* were isolated from the Reconquista River, while *Citrobacter freundii*, *Pseudomonas aeruginosa*, *Pseudomonas luteola*, *Vibrio fluvialis,* and A*eromonas hydrophila* were detected in the nearby Matanza and Luján rivers.

Keywords: *Aquatic bacteria, river pollution, urban river ecology*

INTRODUCTION

Urban rivers are inevitably affected, to varying degrees, by domestic and industrial activities. Megacities have been stressed as the best examples for environmental and public health effects of water degradation caused by insufficiently treated effluents [1]. Buenos Aires city and surroundings is one of the most populated urbanizations of the World. It is crossed by the Reconquista River in its central and western sectors and by the Matanza River in its southern part. Water quality of these rivers is heavily deteriorated in both physicochemical and biological aspects [2, 3, 4, 5, 6, 7].

In a recent publication, a bacteriological assessment of the Reconquista River was carried out over a three-year period at fourteen sites located along the main course and six tributary streams [8]. Results showed high levels of microorganisms for all the stations. Seventeen bacterial species were recorded from the surface water samples, most of them of great sanitary significance and associated with nosocomial infections.

Kuczynski et al. [9] studied the nourishment and the trophic chain of a population of the spotted catfish from the lower Reconquista River basin. They observed elevated bacterial concentrations in gills, intestine and stomach, indicative of high water pollution. The isolated bacteria from these organs were closely related to human and animal diseases.

Many investigations [3, 10, 11] indicate that the Matanza-Riachuelo River is one of the most polluted courses in South America, showing extremely high levels of undesirable chemical substances. Bacterial amounts also demonstrated an unacceptable water quality, but previous references did not emphasized on taxonomic species level.

In the present paper, the occurrence of new records of pathogenic bacteria from these rivers is reported, with an analysis of their ecological and health significance.

MATERIALS AND METHODS

North part of Buenos Aires province, Argentina, is crossed by short lowland rivers which discharge into the Plata River, one of the biggest drainage basins of the world. The Reconquista River extends towards the central and west part of the "Great Buenos Aires" (Federal District and surrounding counties). The Luján River flows across the north part and the Matanza-Riachuelo across the southern sector (Figure 1). These

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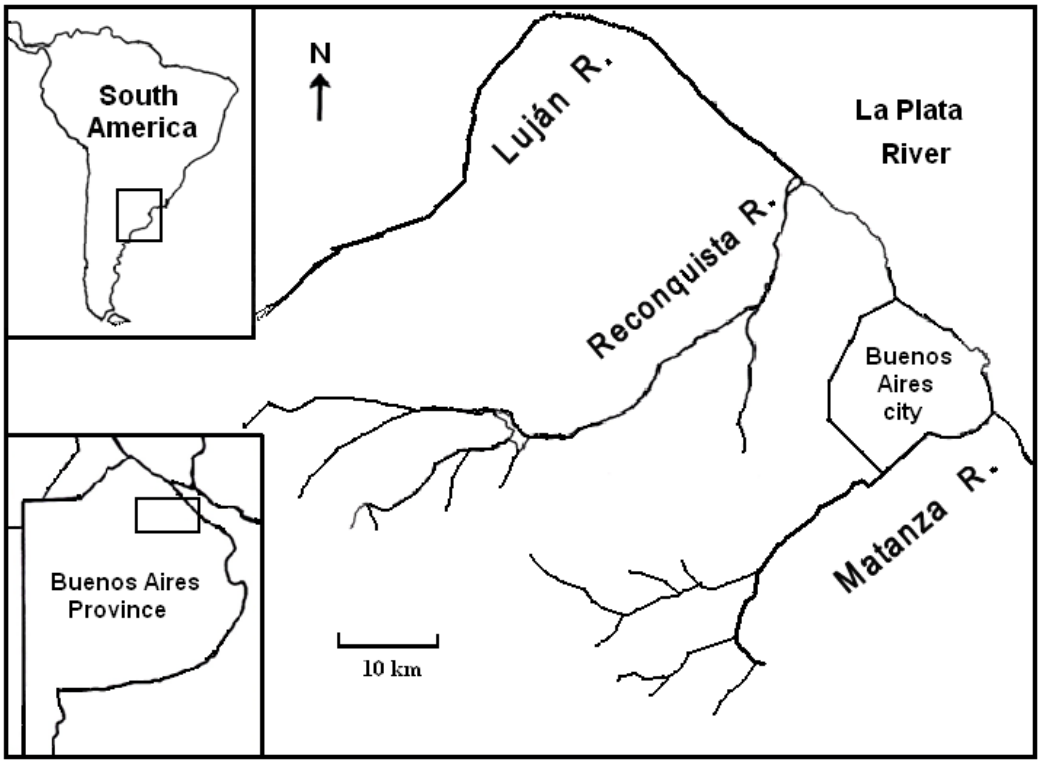

Figure 1. Map of the studied area showing location of the rivers

watercourses were visited for sampling in different sections. Samples were taken on surface water in sterile screw capped bottles and immediately transferred to laboratory. Bacterial isolation was determined according to standard methods [12]. For taxonomic analysis and species confirmation the bioMérieux API® biochemical test systems were employed.

RESULTS AND DISCUSSION

Analyses allowed the finding of the following records:

a. In the Reconquista River, *Yersinia enterocolitica* in the middle basin and in several tributary streams; *Klebsiella pneumoniae* subsp. *rhinoscleromatis* in the middle basin of the river and *K. pneumoniae* subsp. *ozaenae* in its lower basin.
b. In the Matanza River, *Citrobacter freundii*, *Pseudomonas aeruginosa* and *Pseudomonas luteola*.
c. In the lower part of the Luján River, *P. luteola*, *Vibrio fluvialis,* and *Citrobacter freundii*.

All the isolated constitute new geographical data for the respective watercourses. They have been mentioned by the literature as pathogens of great sanitary relevance. Their occurrence in surface water samples should be discussed.

Y. enterocolitica is widespread in natural environments [13]. The bacterium resides in diverse aquatic and terrestrial niches as well in the intestinal tract of numerous animals that act as a natural reservoir. It has been considered as a re-emerging waterborne pathogen [1, 14, 15] and reported from rivers located in many countries like Egypt [16], Italy [17], Brazil [18], Nigeria [19] and USA [20, 21]. The species showed to be resistance to adverse environment factors [22, 23] and can survive even in drinking water [24, 25, 26]. *Y. enterocolitica* was isolated from human feces in Argentina [27] and Uruguay [28], but it has not been previously reported from surface river waters for the region.

K. pneumoniae is ubiquitous in nature, frequently found in soil and water. It is considered an important opportunistic pathogen and a common cause of nosocomial infections. The species shows a widespread distribution in surface water [29], but it has not been reported previously for the studied area. The pathogenic potential of environmental *K. pneumoniae* isolates has been considered as essentially unknown [30]. Subspecies are also of sanitary relevance. *K. pneumoniae* subsp. *ozaenae* and *K. pneumoniae* subsp. *rhinoscleromatis* have been associated with chronic diseases of the upper airways which remains endemic in tropical and subtropical areas [31]. In the present research both

subspecies have been found in different sectors of the River Reconquista basin, proving to be geographically separated.

V. fluvialis infections are common in areas with contaminated water. It was stressed as a global re-emerging pathogen of special sanitary risk in developing countries [32]. It has been frequently found in Reconquista River samples, especially in its middle basin [8]. *C. freundii*, *P. aeruginosa,* and *P. luteola* have been found in many aquatic ecosystems worldwide and have also been considered as opportunistic pathogens responsible for diverse infections [33, 34, 35, 36]. They have been previously isolated from the Reconquista basin [8]. The present paper extends its distribution to the Matanza and Luján rivers.

These watercourses receive effluents discharged from diverse sources, both industrial and domestic. The Matanza-Riachuelo River particularly has been reported as one of the most polluted rivers from South America. Official information about location of discharge points in the analyzed rivers did not provides sufficient basis for an adequate analysis. Most of the study area is densely populated having different degrees of urbanization. Industries, housings, health care facilities and other constructions are not properly separated to assure or to facilitate suitable tasks of pollution and health prevention. All the considered sites may act as potential sources for affecting watercourses. Discharge points are widely spread throughout these river basins and many of them are clandestine or insufficiently identified, so it is no possible to make a correlation between microorganisms and discharge sites at the present time. These considerations emphasize the importance of future programs to identify critical sites and elaborate reliable maps of discharges.

Though many bacterial species are ubiquitous and constitute normal components of the bacterioplankton, they can act as opportunistic organisms and their occurrence always represents a potential risk for human and environmental health.

Furthermore, region´s climate has become warmer and more tropical in the last 20 years, in accordance with global climate changes [37, 38], meaning subsequent impacts on biological communities. Their possible effects on waterborne organisms, especially pathogenic bacteria, have not yet been properly considered and evaluated.

CONCLUSION

New records of bacterial species from the main rivers related to Buenos Aires city and surroundings are reported. Pathogens occurred in surface waters in all the analyzed courses. Recorded species have been associated with diverse nosocomial infections, but it is no possible to make a correlation between microorganisms and specific discharge sites at the present time.

The occurrence of isolated presents a potential risk for human and environmental health. Impact of regional climate warming on waterborne organisms also constitutes a related subject which should be considered and evaluated.

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