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Chemical contamination of water and sediments in the Pardo River, São Paulo, Brazil

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Abstract

River pollution in urban areas may pose human health risks, due to the exposure to chemicals through direct contact, as well as the intake of contaminated fish, agricultural products and water. Pardo River is an important Brazilian water body which flows through two economically important states (São Paulo and Minas Gerais), and it is currently considered as a future drinking water supply option. In the present study, the concentrations of a number of herbicides (by Gas Chromatography with Nitrogen Phosphorous Detector-GC/NPD) and metals (by Inductively Coupled Plasma Mass Spectrometry-ICP/MS) were determined in samples of water and sediments collected along the Pardo River, São Paulo, Brazil, during wet and dry seasons. The presence of atrazine, ametrine, hexazinone and tebuthiuron was verified in water samples, being maximum levels 0.32, 0.27, 0.21 and 1.02 µg/L, respectively. Cadmium, Cu and Zn maximum levels were above national thresholds according to the CONAMA Resolution No. 357/2005 (3.33, 14.6 and 408 µg/L, respectively). In sediments, the highest concentrations were observed for Al and Mn (29,414 and 9,531 mg/kg, respectively). In conclusion, the presence of environmental pollutants in water and sediments from the Pardo River is not insignificant, highlighting the potential risk for the population living nearby and in direct/indirect contact with river water. Metals detected above national thresholds may be coming from urban sewage, mining activities, fertilizers and industrial effluent. As our findings have important public health implications, we suggest a system of monitoring that needs to be implemented and can guide adequate actions to improve the resources quality.

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1. Introduction

Chemical contamination on river waters can originate from many sources, ranging from accidental or intentional discharges by punctual or diffuse pollution. Chemical pollutants, such as metals and herbicides, present toxicity and bioaccumulation characteristics that can be harmful for both environment matrices and human populations [1]. The location of the river, the status of the riparian forest preservation and the economic activities developed in the river basin are also decisive for surface water pollution. Thus, metals and pesticides monitoring in rivers which are developed intense industrial and agricultural activities is very important, in order to generate relevant information to the authorities, focused the environment and public health.

The river pollution by metals and herbicides may harm the human health through direct contact, drinking water, contaminated fish and agricultural products irrigated with the river water. The human health effects related to the exposition to some chemical compounds include endocrine disruption, neural disorders and cancer [2].

Inadequate use of herbicides may affect the river water quality, can cause adverse effects on non-target species, air pollution from volatile substances, injury on non-target plants, wrong application timing or unfavorable environmental conditions at and after application, among others. It is known that the agricultural soil is the primary recipient of these substances, but adjacent water bodies are frequently the ultimate recipient for herbicides residues [3]. The estimation of the bioavailable fraction of metals by the calculation for a period of time by river water passive samplers is interesting because this fraction can cause toxicity and bioaccumulation [4]. DGTs is a passive sampling method based on a layer of resin impregnated on hydrogel to accumulate ionic metals and species, which are in labile equilibrium with those capable to bind to the binding agent [5].

The aim of this study was to evaluate chemical contamination in the Pardo river water and sediment related to the economic activities developed at the region. We conducted four sampling campaigns in six sites along the Pardo River, monitoring the bioavailable fraction of metals by passive sampling with DGT in river water and total metal concentration in sediment, and also the herbicides concentrations in river water.

Nomenclature

DGT	Diffusive Gradient in Thin-Films
PPA	Permanent Protection Area
CETESB	São Paulo State Environmental Authority
Al	Aluminum
As	Arsenic
Cr	Chrome
Pb	Lead
Cu	Copper
Mn	Manganese
Ni	Nickel
Zn	Zinc
Cd	Cadmium
Hg	Mercury
Tl	Thallium
Be	Beryllium
Sn	Tin
V	Vanadium

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