Occurrence and multiple-level ecological risk assessment of pharmaceuticals and personal care products (PPCPs) in two lakes of China

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Abstract

Background: Management of pharmaceuticals and personal care products (PPCPs) in the environment has become a social problem. In the present study, concentrations of 140 PPCPs at 20 sites in Baiyangdian Lake and Tai Lake from 2016 to 2017 were analyzed by Ultra Performance Liquid Chromatography Mass Spectrometer (HPLC-MS). Risk quotients (RQ) were calculated for each detected chemical at all sites and a prioritization index (PI) based on maximum RQ was calculated. To assess the risk of chemicals that identified high priority ($PI > 1$), a more accurate method of joint probability curves (JPCs) was applied.

Results: A total of 41 PPCPs were quantitatively detected in the two lakes, with maximum concentrations ranging from 0.04 to 889 ng/L. Among these, seven PPCPs were identified as high or moderate risk pollutants for at least one site, 3 in Tai Lake and 5 in Baiyangdian Lake. Carbamazepine posed ecological risk at all 20 sites, to which more attention should be paid in the future. Based on results of the JPCs, sulfamethoxazole, caffeine, diethyltoluamide, and carbamazepine were categorized as high or intermediate risk.

Conclusion: Occurrences and distributions of PPCPs were different in the two lakes. Multiple-level risk assessment from simple to more complex was appropriate in chemical risk management.

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF.

Figures

Figure 1

Map of the sampling locations for surface water in Lakes Tai and Baiyangdian. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

Figure 2

Relative compositions of PPCPs in water of Tai and Baiyangdian Lakes. CAF: Caffeine; VST: Valsartan; CTN: Cotinine; DEET: Diethyltoluamide; TDF: Triadimefon; CMP: Carbamazepine; IBU: Ibuprofen; SDN: Sildenafil; LID: Lidocaine; TMP: Trimethoprim; ONP: Oxidized nifedipine; CPM: Chlorpheniramine; TBZ: Thiabendazole; OCBZ: Oxcarbazepine; BP: Butylparaben; FMT: Famotidine; MP: Methylparaben; MCZ: Miconazole; MF: Metformin; ECZ: Econazole; FNC: Flufenicol; LIN: Lincomycin; SP: Sulpiride ; CPD: Clopidol; GBP: Gabapentin; NAL: Nalidixic Acid; 2ABI: 2-Aminobenzimidazole; TCS: Triclosan; HCT: Hydrochlorothiazide; SMX: Sulfamethoxazole; TMR: Triamterene; CMPE: Carbamazepine epoxide; AP: Antipyrine; CTZ: Cetirizine; FCZ: Fluconazole; TBZ: Triclabendazole; GFV: Griseofulvin; ABZSO: Albendazole-Sulfoxide; BMZ: Benzimidazole; ABZ: Albendazole; MEF: Mefenamic acid.

Figure 3

Risk quotients of PPCPs in Tai and Baiyangdian Lakes of China

Figure 4

Joint probability curves for estimated measured environment concentrations of high prioritized PPCPs in Tai and Baiyangdian Lakes. Three reference lines were used to categorize risk as de minimis, lesser, intermediate or greater.

Figure 5

Comparisons among point-estimates of exposure and effects for the four high prioritized

PPCPs. SMX: Sulfamethoxazole; DEET: Diethyltoluamide; CAF: Caffeine; CMP-T:

Carbamazepine in Tai Lake; CMP-B: Carbamazepine in Baiyangdian Lake.

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