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Estrogenic activity, chemical levels and health risk assessment of municipal distribution point water from Pretoria and Cape Town, South Africa

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ABSTRACT

Endocrine disrupting chemicals (EDCs) are ubiquitous in the environment and have been detected in drinking water from various countries. Although various water treatment processes can remove EDCs, chemicals can also migrate from pipes that transport water and contaminate drinking water. This study investigated the estrogenic activity in drinking water from various distribution points in Pretoria (City of Tshwane) (n ¼ 40) and Cape Town (n ¼ 40), South Africa, using the recombinant yeast estrogen screen (YES) and the T47D-KBluc reporter gene assay. The samples were collected seasonally over four sampling periods. The samples were also analysed for bisphenol A (BPA), nonylphenol (NP), di(2-ethylhexyl) adipate (DEHA), dibutyl phthalate (DBP), di(2-ethylhexyl) phthalate (DEHP), diisononylphthalate (DINP), 17b-estradiol (E2), estrone (E1) and ethynylestradiol (EE2) using ultra-performance liquid chromatography-tandem mass spectrophotometry (UPLC-MS/MS). This was followed by a scenario based health risk assessment to assess the carcinogenic and toxic human health risks associated with the consumption of distribution point water. None of the water extracts from the distribution points were above the detection limit in the YES bioassay, but the EEq values ranged from 0.002 to 0.114 ng/L using the T47D-KBluc bioassay. BPA, DEHA, DBP, DEHP, DINP E1, E2, and EE2 were detected in distribution point water samples. NP was below the detection limit for all the samples. The estrogenic activity and levels of target chemicals were comparable to the levels found in other countries. Overall the health risk assessment revealed acceptable health and carcinogenic risks associated with the consumption of distribution point water.