PRESENCE OF ESTROGEN HORMONES AND ANTIBIOTICS IN THE ENVIRONMENT

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In recent years, the detection of trace amount of pharmaceutically active compounds (PACs) in the surface water has gained widespread attention. The presence of the PACs in the natural water systems causes ecological problems and possible adverse effects to humans. Two classes of PACs, estrogen hormones and antibiotics make their way into the surface waters through effluents from wastewater treatment plants and areas where animal manure and biosolids are land applied, amongst other sources. Feminization of fish has been well documented and is used as a biomarker of estrogen pollution. Concentration of 1 to 10 ng L^{-1} of 17 β-estradiol and 0.1 ng L^{-1} 17α-ethinyl estradiol can cause vigtellonensis in male rainbow trout. The presence of antibiotics allows disease causing bacteria to build a resistance; therefore, some antibiotics once used to treat diseases are now becoming ineffective.

Two municipal wastewater treatment plants (WWTPs) in southeastern Pennsylvania were sampled to determine the influent and effluent concentrations of 12 natural and synthetic estrogen hormones along with the effluent concentration of 12 antibiotics and one antidepressant (venlaflaxine). The target estrogens were: 17α-estradiol, estrone, estriol, equilin, 17α-dihydroequilin, 17 β-estradiol, 17 α-ethinyl estradiol, gestodene, norgestrel, levonorgestrel, medrogestone and trimegestone. The target antibiotics were: oxytetracycline, chlorotetracycline, tetracycline, sulfamethoxazole, sulfamethazine, trimethoprim, lincomycin, norfloxacin, ofloxacin, roxithromycin, erythromycin and tylosin tartrate. One WWTP employed a packed bed trickling filter and the other used a continuously-stirred activated sludge process. Four estrogen hormones were detected in the influent and effluent of in both plants. The concentration of estrogens in the influent samples of both treatment plants ranged from 1.2 to 259 ng L^{-1}. The concentration of estrogens in the effluent samples ranged from 0.4 to 22 ng L^{-1}. The detection limits for all 12 estrogen compounds ranged from 0.1 ng L^{-1} to 10 ng L^{-1} using a sample size of 1 L. Eight antibiotics and venlaflaxine were detected in the effluent with concentrations that ranged from 50 to 2,930 ng L^{-1}.

Twenty-one streams in Chester County, southeast Pennsylvania, were also sampled for aqueous concentrations of the above hormones and antibiotics. Chester County represents a very diverse land use. In addition to concentrated urban developments, there are many agricultural farms (dairy, cattle, hog, poultry, and mushroom). The watershed is comprised of about 280,000 acres that eventually drain into the Chesapeake Bay via the Susquehanna River. The results showed that there was at least one estrogen detected in every stream sampled and six estrogens were detected at three different locations. The most abundant PAC was estrone, which was detected in all but one stream, with concentrations as high as 2.4 ng L^{-1}. The second most frequent compound detected was estriol, with a maximum concentration of 19.7 ng L^{-1}, the highest of any other PAC. Out of the 14 antibiotics tested none were detected at any of the stream locations during the sampling time of October 20 to December 6, 2004.

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