

SYSTEMATIC REVIEW ON THE OCCURRENCE OF CONTRACEPTIVES IN THE AQUATIC ENVIRONMENT

Heba Ghazal

School of Life Sciences, Pharmacy and Chemistry, Kingston University, Penrhyn Road, Kingston Upon Thames KT1 2EE, UK, H.Ghazal@kingston.ac.uk

ABSTRACT

Contraceptives are one of the highly used medications globally and over the last few years and their presence in the environment has become a concern. Due to their potential environmental impacts and health risks even at minute concentrations, contraceptives have been identified as the main compounds responsible for endocrine alterations in marine wildlife. Contraceptives enter the aquatic environment through excretion and inadequate disposal, it is estimated that approximately 700kg of synthetic estrogens (17 α -Ethinylestradiol-EE2), primarily from the birth control pill being discharged through the urine and feces of premenopausal women annually. Given EE2's varied use, humans are not only responsible for presence of estrogens in the environment, livestock and aquaculture also share the blame. This has had the cumulative effect of the bioaccumulation of estrogens in water, including rivers, lakes and estuarine where sediment acts as a sink for EE2 in these water bodies and concentrations observed were 1000 times higher. On top of this EE2 a half-life of 17 days meaning it can remain in water for prolonged periods of time, increasing the environmental exposure to both humans and aquatic wildlife. These core design components of contraceptives; high oral bioavailability and resistance to degradation is ideal for contraceptives to be effective in their function but simultaneously render traditional wastewater treatments ineffective in their ability to properly remove used contraceptives from sewage effluents and leading to their accumulating presence in water as emerging contaminants. The aim of this review is to examine studies conducted over the last ten years on the occurrence of contraceptives in the aquatic environment, to assess the scale of the problem and make recommendations for future research based on any gaps in research found during the course of this review. This review included literature search conducted on PubMed yielding 187 articles. The second step was the inclusion and exclusion of articles for review this was carried out by doing title and abstract screening, followed by full text screening, and assessment of the quality of the studies. This step allowed for the total number articles being included as 28 articles. From these articles, the most compounds

identified were EE2, Ethinyl oestradiol, Mestranol, Levonorgestrel and Drospirenone, which were sampled from nine aquatic sources, using five different extraction methods. Sixteen analytical methods were employed for the detection and quantification of these compounds with liquid chromatography being the most common method. Aside from liquid chromatography, gas chromatography was used, as well as electrochemical analysis using voltammetry and multi-walled carbon nanotubes/glassy carbon electrode. This review identified several gaps in research surrounding the occurrence of contraceptives in the aquatic environment, the most important gap in research being the absence of a standardised method in measuring the occurrence of contraceptives in the aquatic environment.