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Environmental Toxicity Caused by Derivatives of Estrogen and Chemical Alternatives for Removal

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There is growing concern over the contamination of water resources by "emerging pollutants" [1,2] that currently fall under the category of pharmaceuticals-specifically as drug residues and their derivatives. This situation is attracting the attention of researchers because the ecotoxicological potential of these productsis unknown. These pollutants are found in small amounts in the environment, which in principle should not bring immediate human health complications; however, the complications and environmental risks to human health during a chronic exposure must be further evaluated [3]. This discussion deserves special attention because there are few, if any, methods for removing these pollutants; research in this field is still emerging but promising.

Emerging Pollutants as Endocrine Disruptors

Some of the compounds that are framed as contaminants are the emerging estrogens and their derivatives such as 17α ethinylestradiol and 17β-estradiol. These hormones, called "endocrine disrupters," are being found in water supplies at concentrations in the range of nanograms, which could pose immediate risks to health and the environment. Chronic exposure causes the feminization of fish, and the consumption of contaminated water can causes endocrine imbalances that can increase the risk of cervical and breast cancer in women and prostate cancer in men [4]. One of the actions attributed to these hormones corresponds to antioxidant effects in living organisms that can influence existing [5] metabolic processes.

The contamination of water resources by estrogen and its derivatives has been extensively studied [6], and current efforts are focused on the identification and removal of these chemical hormones in order to avoid interaction with living organisms. Bio-monitoring the environmental toxicity promoted by estrogen and taking advantage of the use of bioassays has been studied due to the importance of having resources to enable the development of opinions on the acute and chronic toxicity of these environmental hormones in aquatic environments.

Chemical Processes for Removing Endocrine Disruptors

At present, there are various processes aimed at removing both 17β-estradiol and 17α-ethinylestradiol from water supplies and wastewater. While studies are being conducted under varied conditions, the first step must assess how the process occurs and the prospect of these processes under natural conditions [7]. Some studies pursue removal with various solvents; once completed for research in water, they subsequently create situations similar to those found in the environment. Some of the processes for the removal of 17β-estradiol and 17α-Ethinylestradiol are known as advanced toxicity Processes (AOP). These processes are defined as the promotion of a chemical condition that generates hydroxyl radical enough to affect a contaminant molecule in order to remove its known biological activity, thus promoting the purification of water. However, a hydroxyl radical attack complex can begin a cascade of reactions that can lead to the mineralization of organic compounds [8] (Figure 1).

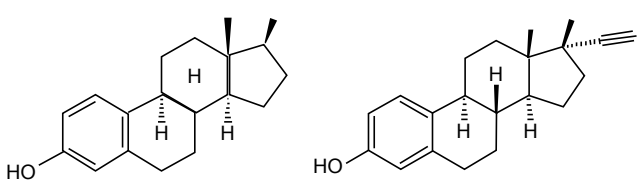

Figure 1: Struture of 17β-estradiol and 17α-ethinylestradiol.

The most commonly used oxidizing agents are hydrogen peroxide (H_2O_2), ozone (O_3), chlorine (Cl_2), and chlorine dioxide (ClO_2). Advanced oxidation processes use H_2O_2/UV, TiO_2/UV, O_3/UV and H_2O_2/Fe_2^+. They differ primarily in terms of cost, applicability in water treatment and sewage, and effectiveness and efficiency in the removal of the pollutant under study. Analyses of the efficiency and effectiveness of these processes has been limited to the chemical aspects of removal, and discussions on the ecotoxicity and the use of bioassays have yet to be explored [9].

Outlook for the Removal Processes

The problem being investigated concerns compounds formed from the employed oxidation processes and whether the generated waste may present a certain degree of acute or chronic environmental ecotoxicity. The commonly employed processes are effective in the removal of endocrine activity, but little is known about the potential risk from the generated waste; studies in this field are necessary at different trophic levels.

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