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Design and Elaboration of Grafted Chitosan Beads for the Removal of Endocrine Disrupter Chemicals (EDCs) from Drinking Water

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PURPOSE OF THE ABSTRACT

During the last 10 years, the appearance of endocrine disrupter compounds (EDCs) in wastewaters and water resources has become a major concern for public health authorities, the entire industrialized world and the agricultural sector. EDCs are one class of micropollutants capable of interfering with the hormonal system of wildlife and producing developmental, reproductive, neurological and immune system disruptions [1]. the two most produced synthetic EDCs attracting the attention of authorities are bisphenol A (BPA, production of 5000 ktons/year) and 4-nonylphenol (NP, production of 225 ktons/year). Because they are widely used (in plastics, construction, paints for BPA; surfactants, washing, textiles for NP), they have been detected at increasing concentrations in our environment. The concentration of these EDCs were measured in drinking water resources in North America, Europe and Asia in the range of 2-14 ug/m3 for BPA and 12-3366 ug/m3 for NP [2-4]. Unfortunately, it has been shown that these compounds can induce estrogenic activity even at concentrations below 1 ug/m3 [1]. To date, no treatment processes have yet been developed for the dedicated removal of EDCs in water ow wastewater treatment. This work describes the development of a method involving modified biopolymer (chitosa) particles for the selective capture of EDCs. In the literature, most of the methods described for the elimination of EDCs (membrane, biological, oxidative) suffer limitations such as high cost, need for post-treatment, generation of toxic side products or low efficiency [5]. The orignial method we propsoe enables the selective trapping of EDCs via simple chemical interactions, which are known to be effective and offere the benefits of fast pollutant removal, low operating cost and simple design [1,6].

Chitosan (CTS), an abudant biopolymer derived from industrial food-processing industray waste (crustacean exoskeleton, fungi, etc.), was valorized by preparing particles (needs) via aqueous precipitation. Next, these particles were decorated with selective polymer grafts in two steps. First, the surface of the CTS beads was functionalized with dithiobenzoate groups under heterogeneous and mild conditions. In a second step, these groups served as actors for the Reversible Addition-Fragmentation chain-Transfer (RAFT) polymerization of 4-vinylpyridine (4VP). Then use of RAFT polymerization allowed us to carefully design and control the molecular weight and disparity of the P4PV selective grafts [7]. Strong interactions between P4VP and PBA have been reported [8]. Finally, the particles were protected from being dissolved in acidic aqueous media by a cross-linking step.

The ability of these CTS-g-P4VP particles to capture BPA and NP from water was demonstrated. The particles were dispersed in water for an appropriate time followed by a settling step, which allowed for an easy separation of the beads from solution. Determination of the remaining BPA and NP concentrations after contact with the particles allowed for the evaluation of removal efficiencies. The influence of different factos (concentration of beads and EDCs, pH and contact time) were investigated to determine the optimal conditions for EDC removal. Finally, the regeneration and re-use of the beads were considered. The selective trapping of BPA and NP is

envisioned to being the ultimate goal for water treatment applications. Clean drinking water is our most essential resource and its quality remains one of the major issues of the 21st century.

FIGURES

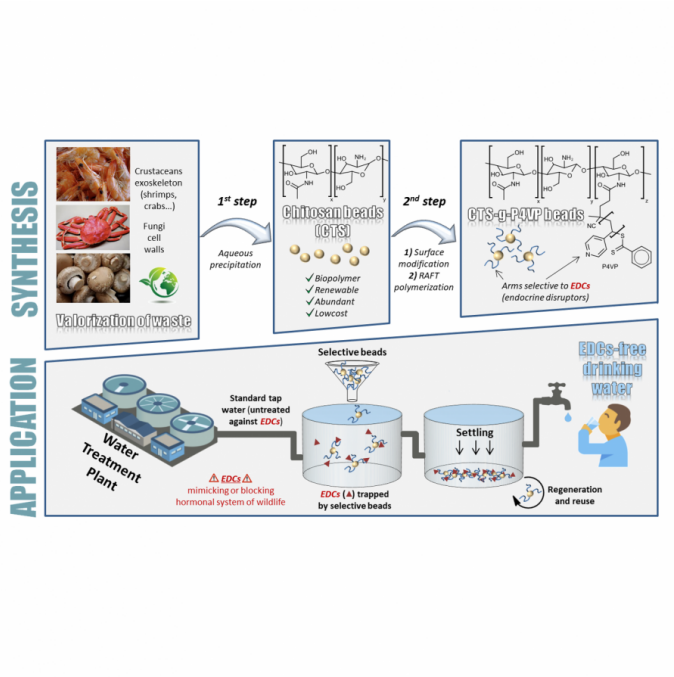

FIGURE 1

Figure 1: Synthesis and application of grafted chitosan beads for the removal of endocrine disrupter chemicals (EDCs) from drinking water

FIGURE 2

KEYWORDS

endocrine disruptor chemicals | chitosan beads | water treatment | modified biopolymers

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