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Photo-driven processes for the removal of biotoxins derived from Harmful Microalgal Blooms

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Harmful Algal Blooms (HABs) are increasing in frequency and magnitude globally. These episodes are associated with the generation of biotoxins, which pose a potential risk to human and animal health. Biotoxins notably affect aquaculture activities and shellfish production, which has a clear impact on food and human health. Consequently, it is sometimes necessary to close the harvesting areas until the organisms are decontaminated. These natural detoxification mechanisms depend largely on the type of toxin and physiology of the organism, resulting in lengthy processes that can cause severe economic losses to aquaculture activities. As the main goal of this communication, we propose a technological alternative for the degradation of marine biotoxins through the implementation of UV technology as a treatment for agricultural, environmental, and health-related purposes. Therefore, advanced photochemical processes should be evaluated for the efficient degradation of marine biotoxins. The toxin selected was okadaic acid (OA), which is a very stable diarrheal toxin (DSP) and has a great impact on shellfish production areas, e.g. on the Portuguese coast. First, irradiation experiments were performed under UV-A, UV-B, and UV-C irradiation. In general, the concentration remained similar after different UV exposures, indicating that there was no observable photodegradation of OA after 3 h of UV irradiation, detecting a maximum degradation of 19.5% (± 0.95) in the UV-C region, suggesting that OA is clearly resistant to UV photodegradation. Second, the combined UV/H_2O_2, UV/HSO_5^-, and UV/$S_2O_8^{2-}$ processes were tested. Two different UV sources were evaluated: LED and low-pressure lamps (LP), performing OA exposure in distilled water and seawater, with a maximum UV exposure of 3 h. In general, a clear degradation of OA is observed in photochemical processes in distilled water, with a slight decrease in efficiency in the UV/H_2O_2 process with an LED irradiation source. In the case of UV/$S_2O_8^{2-}$ and UV/HSO_5^-, both the LP lamp and LED achieved a total degradation of OA. In the case of the marine matrix, the effect is clearly inhibited for the UV/H_2O_2 process; however, for UV/ HSO_5^-, salinity does not seem to affect OA degradation, obtaining practically 100% removal. The study of new UV-LEDs would favor aquaculture activities by increasing sustainability and health safety. Likewise, the results obtained might provide the basis for a possible scale-up of technological processes specifically designed for the minimization

of marine biotoxins.