Environmental behaviour and ecotoxicity of cationic surfactants towards marine organisms

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Cationic surfactants are surface-active compounds. These chemicals can be found in many products, including household and cleaning agents. Therefore, they tend to be discarded into water streams, ultimately ending up in freshwater and marine ecosystem. Despite this environmental issue, studies describing their effects towards marine species are still lacking. Data in literature reports ecotoxicity information mostly for freshwater species, leaving a gap of knowledge on their effects on marine ones. Nevertheless, the available toxicity data in freshwater shows that gemini surfactants are less toxic than their monomeric counterparts.

An assessment on the ecotoxicity and behaviour in seawater of two commercial monomeric surfactants (*N*-cetyl-*N,N,N*-trimethylammonium bromide – **CTAB**, and *N*-dodecyl-*N,N,N*-trimethylammonium chloride – **DTAC**), and three novel gemini surfactants (1,4-bis-[*N*-(1-dodecyl)-*N,N*-dimethylammoniummethyl]benzene dibromide – **QSB2-12**, 3-oxa-1,5-pentamethylene-bis(*N*-dodecyl-*N,N*-dimethylammonium) dichloride – **12-O-12**, and 3-oxa-1,5-tetramethylene-bis(*N*-dodecyl-*N*-hydroxyethyl-*N*methylammonium) dichloride – **MOH-12**) was firstly reported in this article (**Fig. 1**).

The surfactants were tested to evaluate their exposure effects on four marine species, the green microalgae *Nannochloropsis gaditana* and *Tetraselmis chuii*, the diatom *Phaeodactylum tricornutum,* and the crustacean *Artemia salina*. Furthermore, biodegradation and size distribution of the surfactants in artificial seawater were also studied by UV-Vis spectrophotometry and dynamic light scattering, respectively.

Ecotoxicity tests revealed that CTAB is toxic to all tested marine species while DTAC and QSB2-12 showed the lowest toxicity among the tested cationic surfactants (**Fig. 2**). Besides the novel insights regarding the effects caused by these five cationic surfactants, this work opens prospects for the replacement of commercially available surfactants by more environmentally friendly alternatives.

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FIGURE 1
Structure of the tested cationic surfactants.

FIGURE 2
Graphical representation of the main findings and tested organisms.