Human exposure to algal toxins via sea spray aerosols

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Airborne exposure of man to marine natural substances via sea spray aerosols (SSAs) is recently receiving more and more attention. The inhalation of low concentrations of biogenics has been hypothesized as one of the human health promoting mechanisms [1] that causes the epidemiologically observed beneficial coastal health effect [2]. Algal toxins or phycotoxins, such as okadaic acid (OA) and yessotoxin (YTX), are proposed as possible key effect chemicals within this so called biogenics hypothesis. However, no observations have ever confirmed the presence of these specific phycotoxins in SSAs, nor was aerosolisation ever suggested. The only phycotoxins which have been measured within an (natural) aerosol phase, are brevetoxin (PbTx) and ovatoxin (OVTX), and this under favorable sea spray aerosolisation conditions during severe blooms of *Karenia brevis* and *Ostreopsis ovata*, respectively. During these events, when high air concentrations of PbTx (≤ 180 ng m^{-3}) [3] and OVTX (≤ 2 ng m^{-3})[4] are generated, exposed coastal populations may experience respiratory syndromes. These elevated air concentrations are the exception. Background concentrations are usually much lower, certainly for toxins (e.g. YTX) which are produced by non-severe blooming species. The quantification of these low concentrations is not that straightforward. Only in exceptional cases environmental samples contain quantities that exceed the analytical limits of detection and quantification.

This study aimed at the development of new methods to simultaneously quantify multiple phycotoxins in SSAs, in both direct and indirect ways. SSA phycotoxin concentrations were analysed by combining two analytical techniques: ultra-high performance liquid chromatography coupled to high-resolution Orbitrap mass spectrometry (UHPLC-HRMS), and inductively coupled plasma optical emission spectrometry (ICP-OES). With these analytical techniques and the artificial production of SSAs using a marine aerosol reference tank [5], specific phycotoxins were not only detected and quantified for the first time in an (natural) aerosol phase, but also the aerosolisation process itself was studied. Using these newly developed methods in the field, the first data are being generated to assess the environmental air concentrations of phycotoxins which are suggested as potential health-promoting chemicals within the biogenics hypothesis.

References

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