Perfluorinated Sulfonyl and Carboxylic Acids and Precursors in East Greenland Versus Hudson Bay (Canada) Polar Bears

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Introduction

Perfluoroalkyl substances (PFASs) are a wide category of chemicals that include perfluoroalkyl carboxylic acids (PFCAs) and perfluoroalkyl sulfonic acids (PFSAs). These PFASs are not naturally occurring and are anthropogenic in origin [1]. However, because of their large scale production, PFASs and PFCAs are ubiquitous all around the world, and notably in the Arctic. PFCAs and PFSAs can be formed by transformations of precursors such as fluorotelomer alcohols (FTOAs) [2,3]. Also, part of the concern is their ability to biomagnify through food chains [4-6]. The C8 PFSAs, perfluorooctane sulfonate (PFOS), have been replaced by shorter versions, such as: perfluorobutane sulfonate (PFBS), perfluorohexane sulfonate (PFHxS) and perfluorooctane sulfonate (PFHxS) to reduce their bioaccumulation and biomagnification potential [4,5]. There are also new replacement PFASs that have not been reported yet in Arctic biota including perfluoroethylocyclohexyl sulfonic acid (PFETChXs).

PFASs travel by long-range oceanic transport to the Arctic, while their volatile precursors travel by long-range atmospheric transport [7]. PFASs biomagnify through the marine foodweb of the Arctic and end up in the apex predator, the polar bear (Ursus maritimus) [6]. One of the main concerns of PFASs is the fact that the exposure and levels are not necessarily decreasing over the years in the tissues of e.g. East Greenland and Hudson Bay polar bears [9,10].

If fact, East Greenland and Hudson Bay are two contamination “hotspots” regarding PFASs in polar bears, with PFOS levels comparable to e.g. SPCBs [9,10].

Study Objective:

To compare concentrations of legacy and new, bioaccumulative PFASs in polar bear subpopulations from two different contamination “hotspots”, East Greenland and Hudson Bay.

Table 1. Concentration of a suite of PFASs (ng/g wet weight) in polar bear livers from East Greenland (n=10) and Hudson Bay (n=19)

<table>
<thead>
<tr>
<th></th>
<th>Carboxylic Acids</th>
<th>Sulfonific Acids</th>
<th>Non-Acids</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PFBS PFHxS PFHs PFETChx</td>
<td>PFOS PFDS Sum PFSA FBsA</td>
<td>N-Me- N-En- FOSA</td>
</tr>
<tr>
<td>East Greenland</td>
<td>Mean (ng/g wet ww) ± SE</td>
<td>36 0.5 0.3 17 249 61 70 0.2 0.3 924 0.7 18 3.1</td>
<td>2583 5.7</td>
</tr>
<tr>
<td>Hudson Bay</td>
<td>Mean (ng/g wet ww) ± SE</td>
<td>14 0.2 0.8 28 31 60 58 0.2 0.4</td>
<td>1500 2.6</td>
</tr>
</tbody>
</table>

Results

Conclusions

- Results showed that the East Greenland bears are generally more contaminated than Hudson Bay bears (Table 1). This may be due to differences in PFAS sources and/or diet for the two subpopulations.
- Bioaccumulation patterns of PFBS versus the subpopulations were similar. However, Hudson Bay bears contained less PFOS and more FOSA, PFNA, PFDA and PFUDA than East Greenland bears (Fig. 1).
- The ratio of PFOS to its precursor FOSA was very different between the subpopulations, as the East Greenland polar bear subpopulation had a huge concentration of PFOS compared to its precursor (Fig. 2). This suggests that exposure to FOSA is greater and exposure to PFOS is lower for Hudson Bay bears than for East Greenland bears, and/or FOSA to PFOS metabolism is greater for East Greenland bears.

References


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