European Commission

Science for Environment Policy

Environmental and safety concerns raised over POP alternative PFO4DA

26 September 2019
Issue 531

Subscribe to free weekly News Alert

Source: Guo, H., Wang, J., Yao, J., Sun, S., Sheng, N., Zhang, X., Guo, X., Guo, Y., Sun, Y. and Dai, J. (2019) Comparative Hepatotoxicity of Novel PFOA Alternatives (Perfluoropolyether Carboxylic Acids) on Male Mice. *Environmental Science & Technology*. 53 (7): 3929–3937. DOI:10.1021/acs.est.9b00148.

Contact: daijy@ioz.ac.cn

Read more about:
Chemicals, Risk Assessment

A new study has raised safety concerns over PFO4DA, a substance increasingly used as a substitute for PFOA, a harmful persistent organic pollutant (POP), in plastic production. PFO4DA was found to cause liver damage to mice in lab tests, and is also an environmental pollutant. The researchers caution that it may not be a suitable alternative to PFOA.

PFOA (perfluorooctanoic acid) was once widely used in a variety of industrial products. However, it is now restricted in Europe and the USA due to its considerable toxic effects on humans and wildlife, and its widespread presence and persistence in the environment. In Europe, it is restricted through Regulation (EU) 2017/1000[1]. The Conference of the Parties of the Stockholm Convention, an international treaty to protect human health and the environment from POPs, recently listed PFOA in its Annex A (a list of chemicals which the Convention has pledged to eliminate)[2].

Multiether PFECAs (perfluoropolyether carboxylic acids) are perceived to be more environmentally friendly than PFOA. They are used as PFOA replacements in the manufacture of fluoropolymers, which are a group of plastics used in numerous applications such as non-stick coatings on cookware, waterproof clothing and textiles, medical products and battery packing.

Previous studies have detected a number of multiether PFECAs in rivers around the world. However, there is very little data on their toxicity. To the best of the researchers' knowledge, this study is the first to report on the toxic effects of multiether PFECAs on mice. Its results may help clarify the potential health risks of multiether PFECAs to both humans and wildlife.

The researchers compared the toxic effects of PFOA with three different types of multiether PFECA: PFO2HxA, PFO3OA and PFO4DA. In lab tests, they administered these substances to laboratory mice once a day for 28 days. In total, they studied 156 mice; these were divided into groups, with each group receiving a different dose (0, 0.4, 2 or 10 mg per kg of body weight) of a specific substance. After the testing period, the researchers analysed the mice's blood, livers and brains for signs of damage.

The tests did not reveal any toxic effects of PFO2HxA and PFO3OA, although the researchers suggest that further tests are needed to determine their safety as PFOA alternatives. However, this study did show that PFO4DA had a variety of effects on the mice's livers.

For instance, all groups dosed with PFO4DA had enlarged livers, albeit not as severely as for the PFOA groups. The increase in liver weight for the highest dosage (10 mg/kg) PFO4DA group was similar to that for the 0.4 mg/kg PFOA group. Furthermore, liver cell death occurred in the 10 mg/kg PFO4DA group and all PFOA-treated groups.

PFO4DA also disrupted the mice's urea cycle when administered at 10 mg/kg. For instance, this group had reduced CPS1 levels. CPS1 is an enzyme critical to the urea cycle, which is responsible for removing ammonia from the body. Ammonia is highly toxic and can lead to lethargy, central nervous system dysfunction and brain damage. Accordingly, this study found that ammonia levels in the mice's blood increased with the dosage of PFO4DA. They suggest that this disrupted urea cycle may be partly to blame for the liver damage.

Continued on next page.

1. Commission Regulation (EU) 2017/1000 of 13 June 2017 amending Annex XVII to Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards perfluorooctanoic acid (PFOA), its salts and PFOA-related substances: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32017R1000

2. http://chm.pops.int/TheConvention/ConferenceoftheParties/Meetings/COP9/tabid/7521/Default.aspx

European Commission

Science for Environment Policy

Environmental and safety concerns raised over POP alternative PFO4DA

(continued)

26 September 2019
Issue 531

Source: Guo, H., Wang, J., Yao, J., Sun, S., Sheng, N., Zhang, X., Guo, X., Guo, Y., Sun, Y. and Dai, J. (2019) Comparative Hepatotoxicity of Novel PFOA Alternatives (Perfluoropolyether Carboxylic Acids) on Male Mice. *Environmental Science & Technology*. 53 (7): 3929–3937. DOI:10.1021/acs.est.9b00148.

Contact: daijy@ioz.ac.cn

Read more about:
Chemicals, Risk Assessment

This study noted that the mice's disrupted urea cycles also affected their brains. For example, the 10 mg/kg group had significantly reduced levels of the neurotransmitter glutamate in their brains, as well as elevated levels of the APQ1 protein, which transfers water.

The researchers conclude that PFO4DA may not be a suitable alternative to PFOA: it may not be as toxic as PFOA, but can still cause damage. They also highlight a US study[3] that found PFO4DA at much higher concentrations than PFOA in raw water samples from a drinking-water treatment plant. They, therefore, recommend urgent efforts to remove PFO4DA from drinking water — or at least reduce its occurrence.

3.Sun, M. *et al*. (2016). Legacy and Emerging Perfluoroalkyl Substances Are Important Drinking Water Contaminants in the Cape Fear River Watershed of North Carolina. *Environmental Science & Technology Letters*. 3(12): 415–419.