

Forever Chemicals

Perfluorinated compounds focus (including PFAS)

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What are forever chemicals?

Forever chemicals is the popular name given to a group of thousands of very stable chemicals that do not easily break down and so are very persistent in the environment. These synthetic chemicals have a long history of use in industrial and consumer products, such as textiles, food contact materials and packaging, surfactants and lubricants, personal care products, pesticides, pharmaceuticals and fire-fighting foams [1,2,3]. Perfluorinated compounds (Perfluorochemicals; PFCs) have strong carbon fluorine (C–F) bonds giving them thermal, chemical and biological stability [1], and one particular subset that are being considered in terms of food contamination are Per- and polyfluoroalkyl substances (PFASs).

Where do they originate?

The European Union (EU) states that the contamination of food with PFASs is mainly as a result of the bioaccumulation of these persistent chemicals in aquatic and terrestrial food chains, and the use of PFASs in food contact materials [4]. National monitoring activities have identified PFASs in the environment throughout Europe [5, 6]. They can be found in drinking water, soil and water near waste disposal and landfill sites, biosolids from waste treatment works that might be used in agricultural soils, in fish that have lived in contaminated water, and some types of packaging and food contact materials [6,7]. Some studies have considered the challenges with food packaging, specifically the use of recycled packaging materials where PFASs may be present [8]. They have also been intentionally added to food contact packaging to reduce moisture and oil ingress [8].

Why are they a concern with food?

Forever chemicals have been linked to a range of chronic human health concerns including thyroid disease, liver damage, kidney and testicular cancer, increased thyroid levels, reduced response to vaccines, impacts on the immune system, and low birth weights [3, 7, 9]. PFASs have been linked to freshwater fish and sea fish, molluscs, crustaceans, shellfish, meat, eggs (with feed suggested as the source), drinking water, vegetables, milk, baby food and human breast milk [10]. A recent study found PFASs in mothers' first milk, follow-on milk and baby food [1, 11].

What legislation is in force?

On 17 March 2010, the European Commission adopted Commission Recommendation (EU) 2010/161 on the monitoring of PFASs in food [12]. The European Commission has been collecting PFAS data from member states since 2010. The EFSA opinion on the risk to human health related to the presence of PFASs in food was published in 2020 [13]. In December 2022, the Commission published Regulation 2022/2388 which contains a list of maximum permitted levels of PFASs applicable to foods [14]. The regulation amends the main contaminants regulation (Regulation 1881/2006 [15]) by adding maximum levels of PFASs in eggs, meat and seafood. The PFASs subject to these maximum levels are: perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA) and perfluorohexane sulfonic acid (PFHxS). The levels have applied in the EU since 1 January 2023. The UK's retained version of EU Regulation 1881/2006 does not include maximum levels of PFASs applicable to foods.

How easy is it to measure and detect PFAS in food?

Determining dietary exposure to PFASs is a focus for many regulators and food organisations. The US FDA has been developing and refining analytical methods for testing foods since 2012. In 2019, the FDA expanded these methods and endorsed the first single-lab validated scientific method for testing 16 different types of PFAS across a range of foods. In 2021, the FDA optimised this method for use in processed foods [16]. In 2022, the FDA announced additional methods and a specific survey of seafood [17]. Seafood, fruit, eggs, and their

products, were found to be important food categories contributing towards exposure, according to the EFSA Opinion of 2020 [13]. The Opinion found that some freshwater fish species, such as carp, eel, roach and perch, contained amongst the highest levels of PFASs (particularly PFOS) when compared to other types of seafood. This is probably because freshwater lakes (as well as marine water bodies), with long water retention times, allow pollutants to bioaccumulate. Of the marine seafood species, sardines and plaice were the species with higher levels of PFASs; mackerel, herring, tuna and salmon contained lower levels, comparable to those found in eggs; molluscan shellfish contained even lower levels.

What control measures can be put in place in the food supply chain?

The first aspect is to understand how PFASs move through the environment and the food system [18]. Organisations can then undertake specific risk assessments based on the products they produce and/or sell, their target customers e.g. infants, children, vulnerable groups or the general public, and consider the composition of packaging they use, especially food contact packaging, as well as food contact surfaces, throughout the supply chain. Improving supply chain transparency, and phasing out activities or practices of concern, are essential aspects of a due diligence approach. Implementing monitoring and verification programmes, especially focused on PFASs, is also a key element of food safety management programmes. It is important not to consider just direct suppliers, but second and third tier suppliers too. More details can be found in reference [19].

Food businesses need to ask themselves whether they need to consider, and risk assess, PFASs because of legislative requirements, the types of products they are predicting, and packaging they are using, and also the profile of their target consumers. A useful source to consider the mapping of PFAS through your supply chain and for further guidance on potential risk is [20].

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