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In-Depth Investigation on the Occurrence of Per- And Polyfluoroalkyl Substances (PFAS) In Greek Home-Produced Chicken Eggs through LC-MS/MS Analysis

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Extended Abstract

The transfer of per- and polyfluoroalkyl substances (PFAS) into food of animal origin due to their ubiquitous presence in the environment constitutes a serious consumer safety issue [1,2]. Uptake studies have revealed that hens foraging in countryside are exposed to a complex mixture of environmental pollutants, posing a possible threat for human health due to their toxicological properties [3,4]. Thus, diet is one of the main sources of exposure to PFAS [5,6]. However, there is insufficient data regarding the level of PFAS in eggs from household sources, as their consumption is typically restricted to the producer's family or local consumers. In the present study, 10 different classes of 46 PFAS were analyzed to investigate the extent of PFAS contaminations in the free-range local chicken eggs from households and to estimate the potential risk of PFAS intake via egg consumption. For this reason, during the period April-October 2023, 75 home-produced chicken eggs were collected from 14 volunteers that kept free-ranging laying hens. All eggs from each location were sampled on the same day to ensure that the eggs originated from different individual hens. These samples were collected from 5 different prefectures across Greece (Serres, Magnesia, Boeotia, Attica, and Ilia). These areas include one highly urbanized area (Attica), two highly industrialized areas (Magnesia and Boeotia), and two rural areas (Serres and Ilia). Approximately, 5 whole eggs from each household were homogenized and pooled into 17 composite samples. Briefly, an extraction protocol was developed for the extraction of PFAS from the matrix based on a modified QuEChERS (Quick, Easy, Cheap, Effective, Rugged, and Safe) method for samples of animal origin. The instrumental analysis was conducted by ultra-performance liquid chromatography-tandem mass spectrometry (UPLC-MS/MS) using a generic reversed phase gradient elution program for the chromatographic separation and optimized acquisition modes providing broad mass. The Σ_{46}PFAS mean concentration was 7.92 μg/Kg wet weight (ww) and ranged between <LOD and 2.57 μg/Kg ww. The dominant compound class detected were the perfluoroalkyl carboxylic acids (mean Σ_{14}PFCAs 3.40 μg/Kg ww, range <LOD-2.49 μg/Kg ww) which contributed 43% of the total mean Σ_{46}PFAS mass, followed by perfluoroalkyl sulfonates (Σ_8PFSAs mean 2.14 μg/Kg ww, range <LOD-2.57) with 26%. The next highest percentage contributions were from the perfluoroalkyl sulfonamides (Σ_3FASAs mean 1.21 μg/Kg ww, range <LOD-1.92 μg/Kg ww) that contributed an average 16% mass to the Σ_{46}PFAS. The following groups contributed less than 8% to the total Σ_{46}PFAS mass: Σ_3FCAs 8% (mean 0.57 μg/Kg ww, range <LOD -0.236), Σ_2Capstone 3% (mean 0.21 μg/Kg ww, range <LOD -0.327 μg/Kg ww) and the Σ_3FUCAs 2% (mean 0.17 μg/Kg ww, range <LOD -0.086 μg/Kg ww). PFECAs, PFESAs, FTS, and PFPAs groups were also detected infrequently and at low concentrations (<0.2 μg/Kg ww), which collectively contributed less than 1.5% to the Σ_{46}PFAS when present. PFOS was the dominant PFAS contaminant in eggs, contributing 46% to Σ_8PFSAs and 13% to the total PFAS profile. PFOS was also detected at the highest concentration for the PFSAs group in 53% of eggs with a mean concentration of 0.996 μg/Kg ww and ranged between 0.109 to 2.57 μg/Kg ww.

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