

Integrating Ultrashort-Chain Compounds into the Comprehensive Analysis of PFAS in Ready-to-Feed Liquid Milk Samples

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Introduction

Ultrashort-chain (USC) per- and polyfluoroalkyl substances (PFAS) are highly polar compounds with carbon chains shorter than C4. Their widespread occurrence in aquatic environments has raised growing concerns about potential contamination in food products, particularly ready-to-feed liquid milk. To fully assess PFAS contamination, it is essential to include USC compounds in PFAS analysis of milk samples. The high polarity of USC PFAS poses a significant challenge for standard chromatographic practices in PFAS analysis, primarily due to insufficient chromatographic retention. This study introduces a simple and reliable workflow for the simultaneous analysis of C1 to C14 perfluoroalkyl carboxylic and sulfonic acids, along with other PFAS classes, in various liquid milk matrices. The chromatographic analysis was performed using an inert-coated polar-embedded reversed-phase LC column. Method verification was conducted using three different milk types—dairy milk, almond milk, and infant formula—to demonstrate the workflow’s applicability for measuring 41 PFAS in diverse milk samples. A sample preparation procedure involving protein precipitation, extractant drying, and reconstitution, was optimized for effective extraction and quantification of all analytes. The established workflow was then applied to the analysis of additional milk samples collected from various grocery stores, providing a comprehensive profile of PFAS contamination across a diverse range of milk matrices.

Figure 1: Structures of C1 to C3 PFAS

