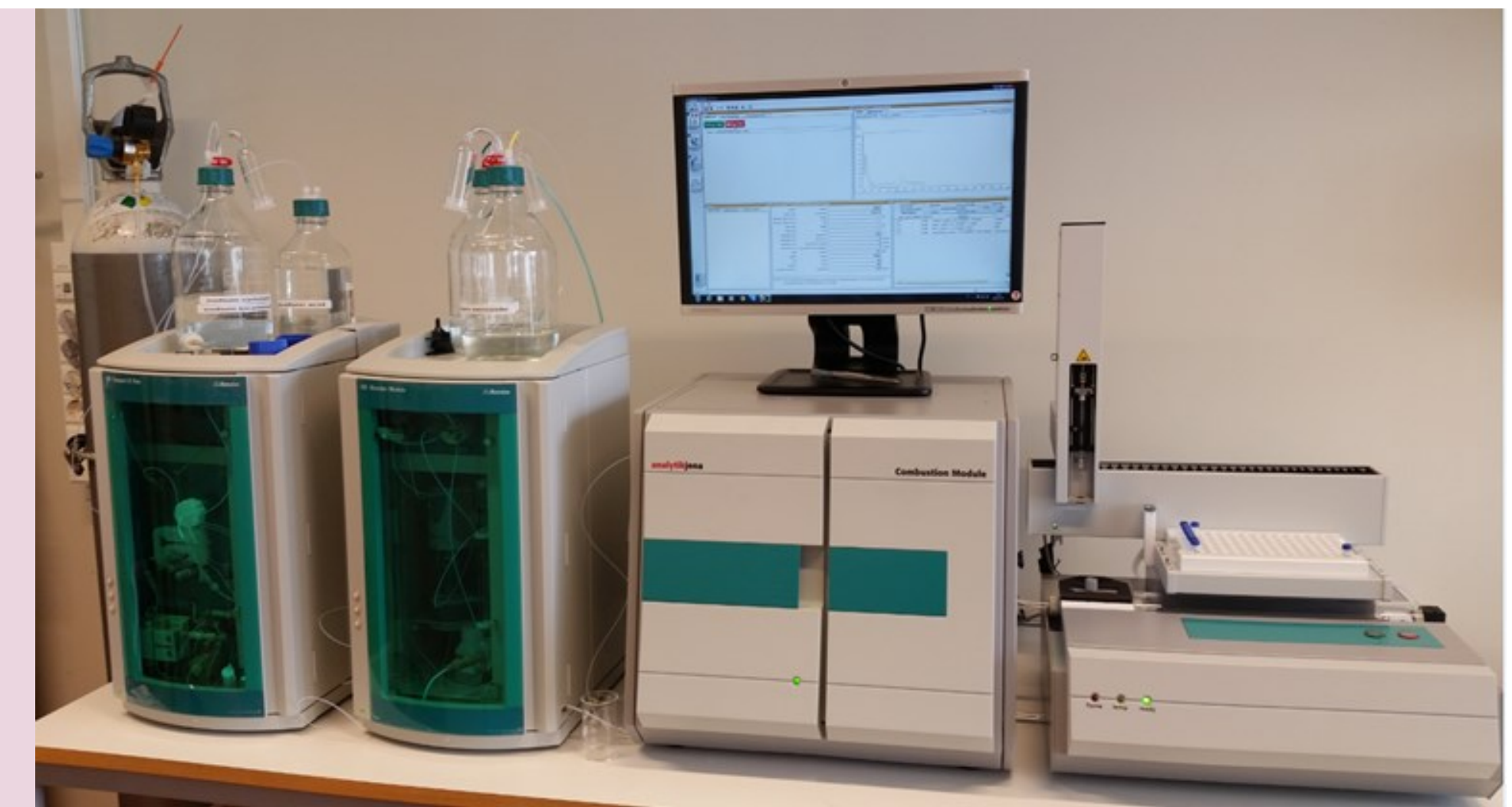


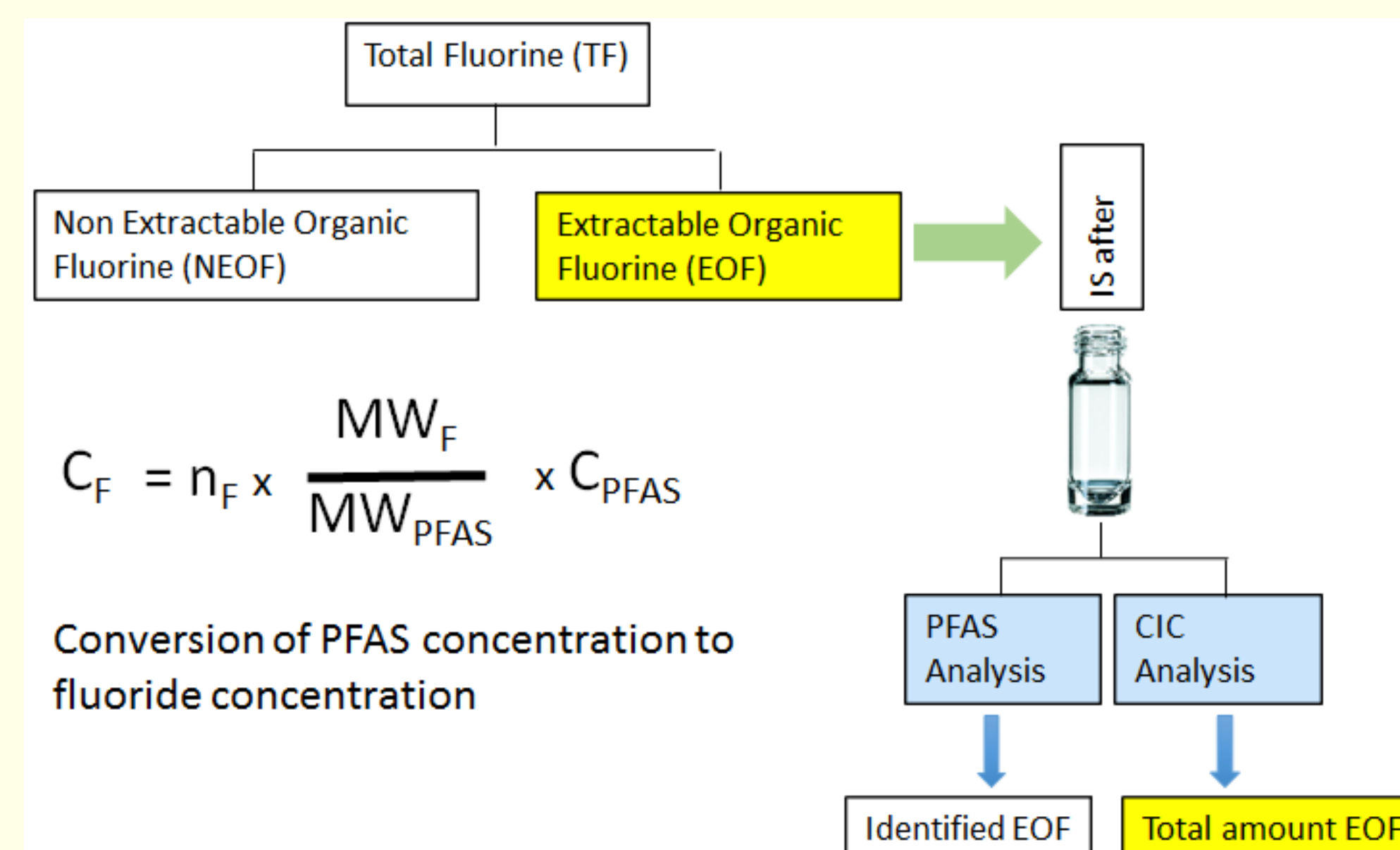
## INTRODUCTION

Per-and polyfluorinated alkyl substances (PFASs) are a large group of several thousand anthropogenic compounds, of which many have been found to be persistence, toxic, and bioaccumulative. They are used in a wide range of applications including consumer products, also those applied directly onto skin such as cosmetics<sup>1,2</sup>. One of the PFAS classes used in cosmetics products are the polyfluoroalkyl diphosphate esters (diPAPs), which are known precursor compounds of perfluorocarboxylic acids (PFCAs)<sup>3</sup>. Personal care products declared with diPAPs content have previously been found to contain high concentrations of PFCAs (not detected to 19 µg/g)<sup>1</sup>. In this study, several PFAS classes and total extractable organic fluorine (EOF) were analyzed in cosmetics declared with organic fluorine content.



## STUDY DESIGN

In this study, the total extractable organic fluorine (EOF) content were measured in 23 cosmetic products. The samples were commercially available at the Swedish market in 2017 and were collected by the Swedish Society for Nature Conservation (SSNC). They were declared with fluorinated compounds content, such as polyfluoroalkyl diphosphate esters (diPAPs), perfluorooctyl triethoxysilane, and fluoropolymer.

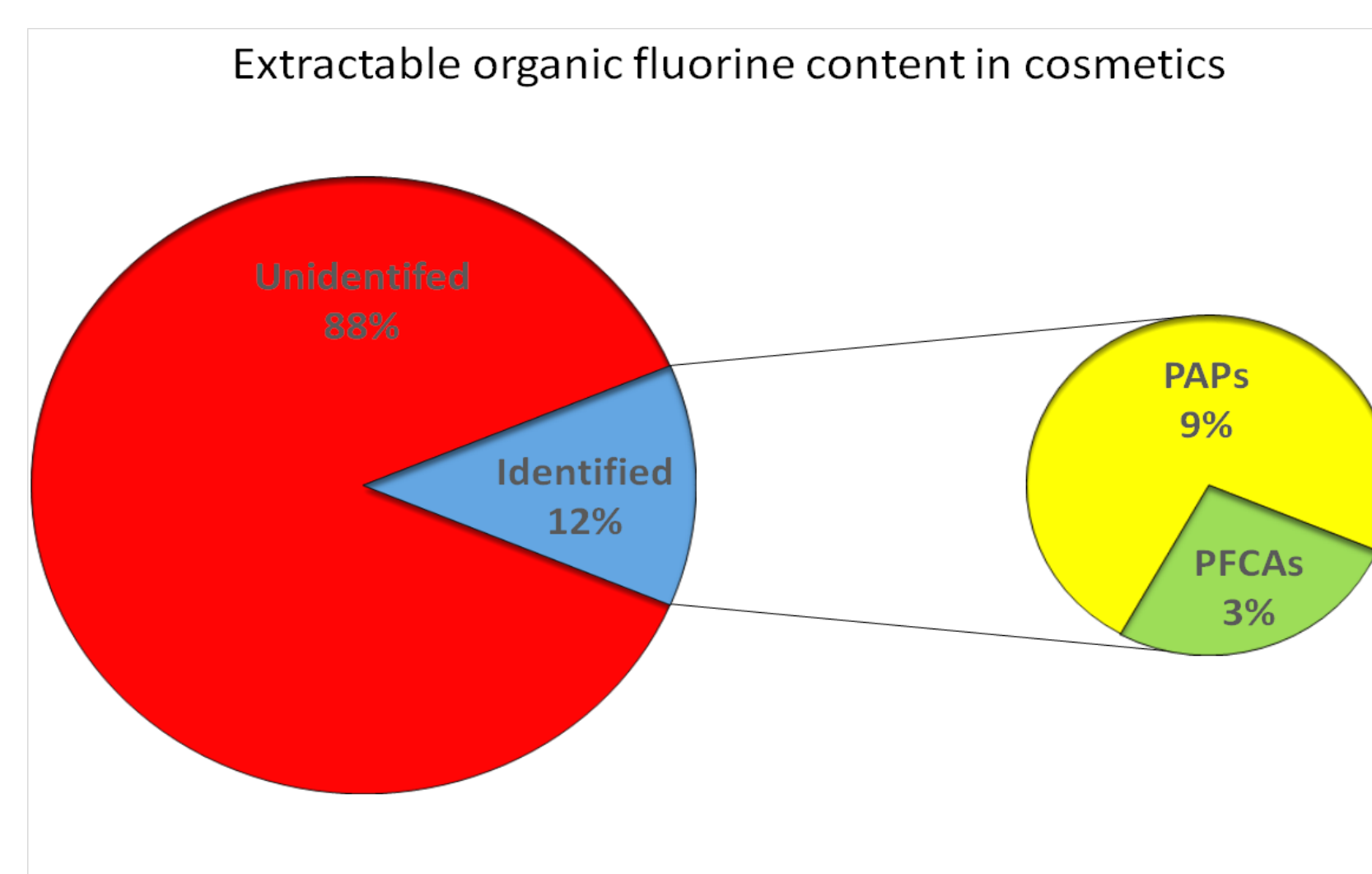


## METHODS

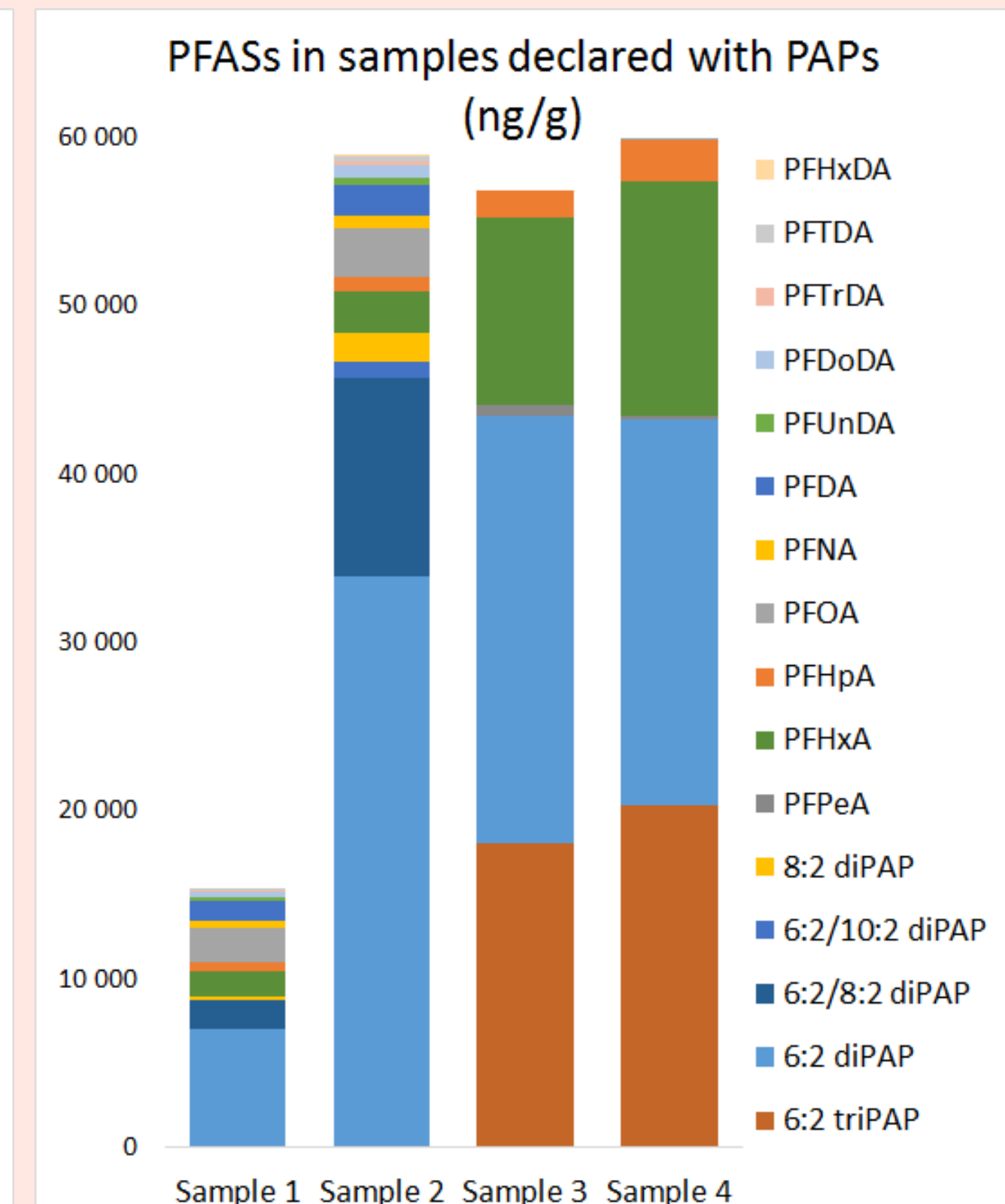
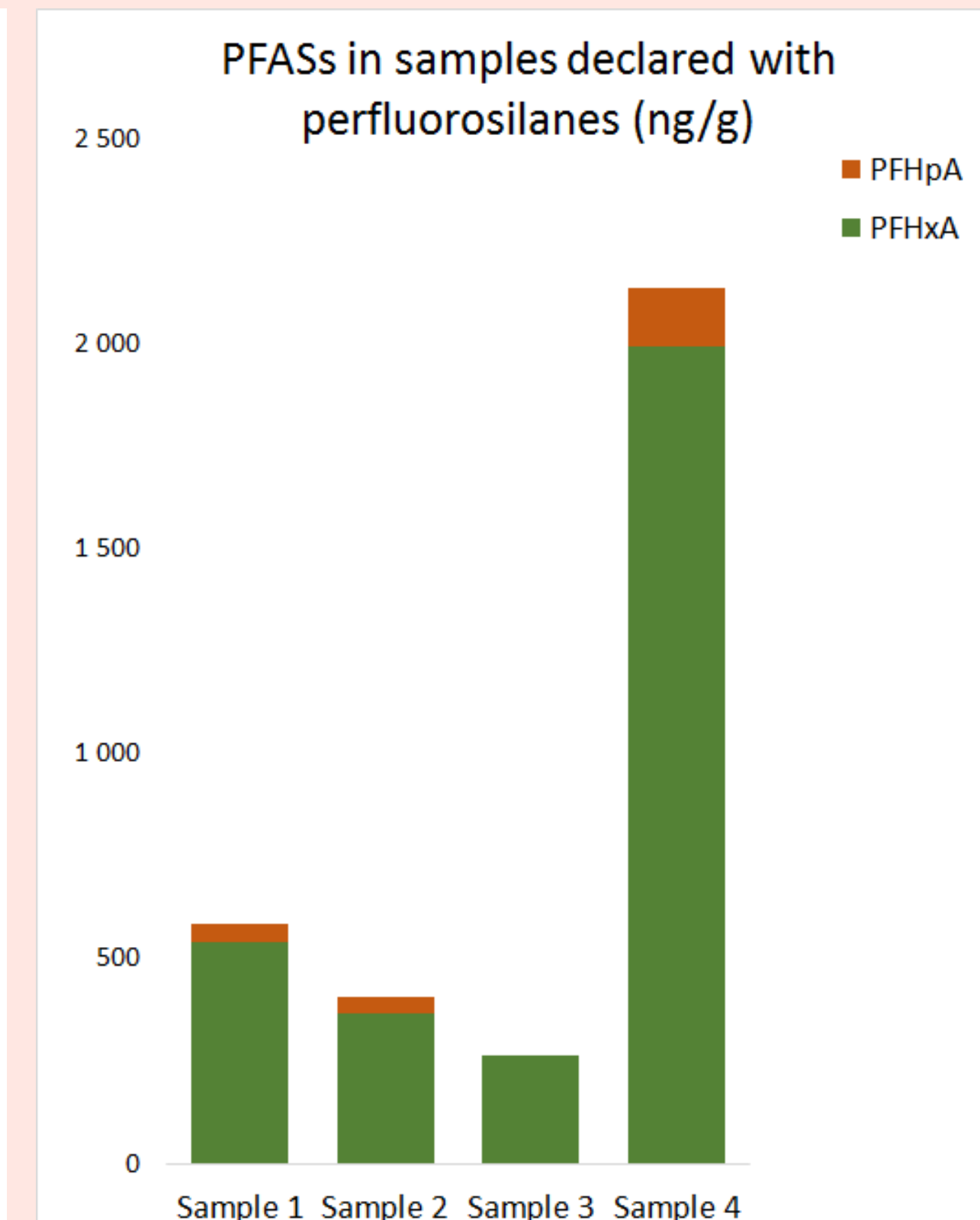
The samples were extracted with acetonitrile and analyzed for TEOF using a combustion ion chromatography (CIC) system, which consists of a combustion module (Analytikjena, Germany) and an ion chromatograph (Methrohm, Switzerland). Targeted analysis of diPAPs and perfluorocarboxylic acids (PFCAs) for mass balance purpose were performed using a Acquity UPLC system coupled to a triple quadrupole mass spectrometer XEVO TQ-S (Waters Corporation, Milford, USA), in negative electrospray ionization mode.

## RESULTS

A vast majority of the samples, 18 of 23, contained detectable levels of EOF in the range of 0.06 µg/g up to 243 µg/g. The greatest levels of TEOF (mean 139 µg/g) were found in samples that were declared with the use of diPAPs, followed by samples declared with perfluorooctyl triethoxysilane content (69 µg/g). The proportion of unidentified PFASs accounted for 7 – 100% of the EOF content.

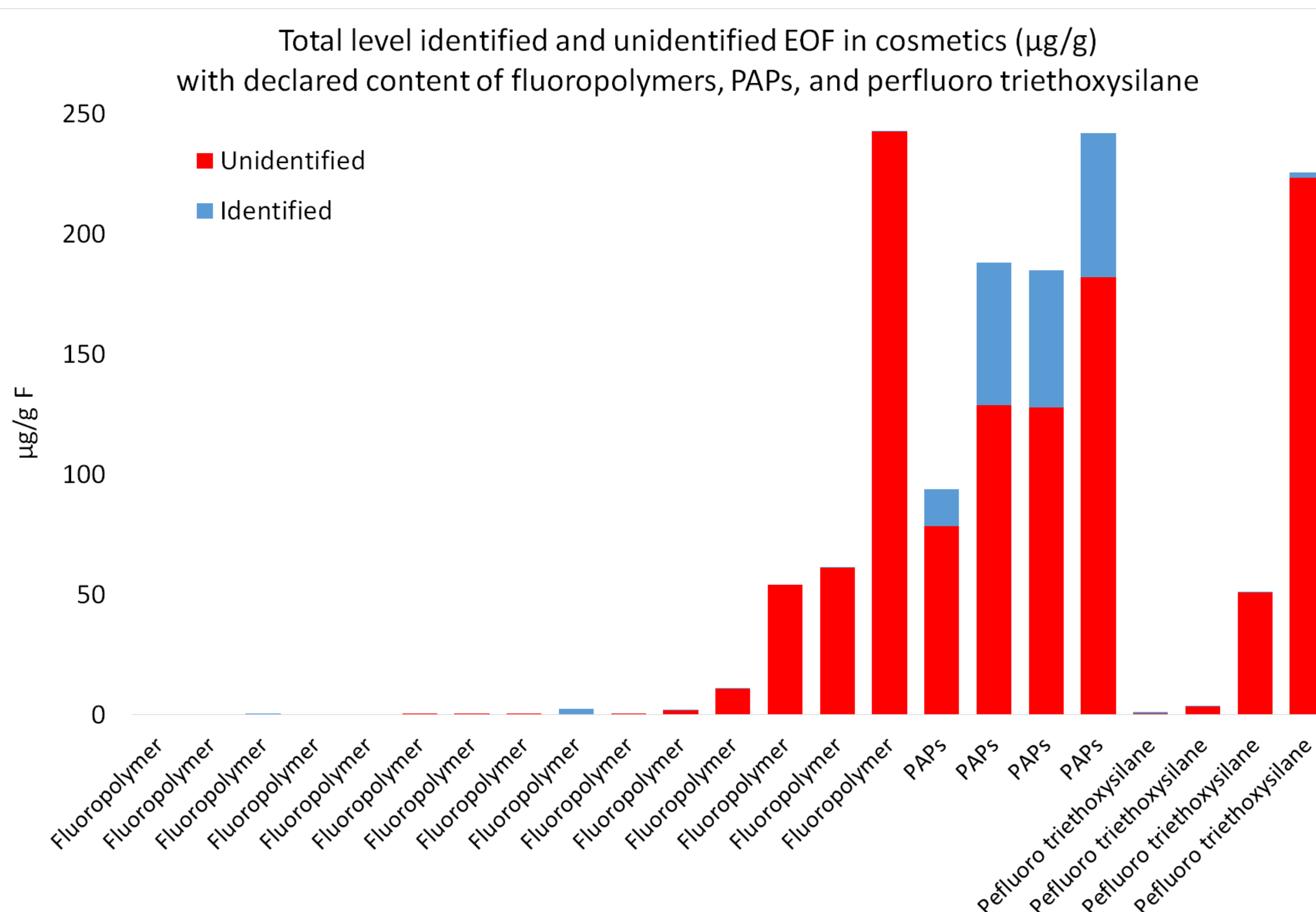


All samples declared with diPAPs and perfluorooctyl triethoxysilane showed detectable levels of PFCAs. In the samples declared with diPAPs, PFCAs accounted for 5.6 – 7.2% of the EOF, and diPAPs accounted for 9.5 – 26% of the EOF. In the samples declared with perfluorooctyl triethoxysilane, PFCAs accounted for 0.5 – 64% of the EOF.



The samples declared with perfluorooctyl triethoxysilanes were dominated by PFHxA, with a minor contribution of PFHpA.

Two distinct profiles were observed in the samples declared with PAPs content, with domination by either C6 homologues (6:2 triPAP, 6:2 diPAP, and PFHxA), or PFCAs and PAPs in the C6–C16 homologue range.



## CONCLUSION

A majority of the EOF content could not be identified by target analysis.

PFCAs were detected in all samples declared with diPAPs and perfluorooctyl triethoxysilane. The different profiles in the samples declared with PAPs show that cosmetic products with longer chain PFASs (C<sub>≥</sub>8) still are commercial available.

The presence of PFCAs in the samples declared with perfluorooctyl triethoxysilane is not clear. Further studies are needed to elucidate whether they are a result of impurities in production, or possibly a result of degradation of perfluorooctyl triethoxysilane.

## ACKNOWLEDGEMENT

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## References

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