

# Ion Mobility Mass Spectrometry-based Untargeted Serum Lipidomics Characterization in the General Chinese Cohort with Residual Per-/Polyfluoroalkyl Substances

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## INTRODUCTION

Per- and polyfluoroalkyl substances (PFAS), the notorious forever chemicals, show potential toxicity to humans.<sup>1</sup> At present, the omics molecular traits of PFAS are mainly from global metabolomics analysis on the industrial exposure cohort. However, the general adult population is prospective considering that the serum from most people contains PFAS. Liquid chromatography-ion mobility-mass spectrometry (LC-IM-MS) resolved four-dimensional (4D) lipidomics has received increased attention for exploring differences in phenotype, showing great potential to be applied in the field of environmental regulations. In this study, the specific characterization of multiple lipid compositions and pathways could provide stronger evidence for the future development of health-protective guidelines.

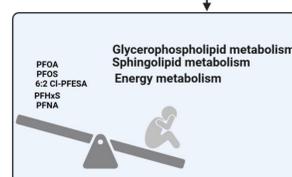
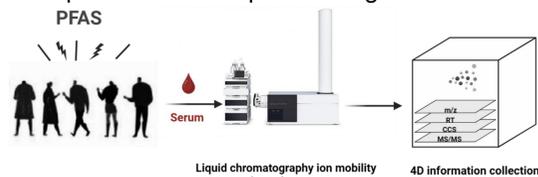


Figure 1. PFAS residual and the serum lipidomics characterization

## EXPERIMENTAL SECTION

**Study population:** A total of 40 serum samples from a general population were divided in two groups with relatively high (n = 20) and low levels of residual PFAS.

Table 1. Demographic characteristics of the participants at baseline (n = 40)

Characteristics		Lowest 20	Highest 20	P-value	Statistic methods
Gender, n (%)	Male	10 (50.0)	10 (50.0)		
	Female	10 (50.0)	10 (50.0)		
Age, years		48.2 ± 14.1	50.7 ± 12.7	0.572	t-test
BMI		25.3 ± 3.3	25.8 ± 3.7	0.616	t-test
Height, m		1.6 ± 0.1	1.7 ± 0.1	0.691	t-test
Weight, kg		68.8 ± 11.0	71.5 ± 14.2	0.520	t-test

### Top five predominant PFASs in the general population

PFOA, ng/mL	1.630 (0.810, 2.720)	3.020 (2.130, 4.710)	<0.001	Mann-Whitney-U
PFOS, ng/mL	0.642 (0.466, 1.102)	4.104 (2.227, 5.064)	<0.001	Mann-Whitney-U
6:2 Cl-PFESA, ng/mL	0.641 (0.464, 0.799)	1.889 (1.030, 2.958)	<0.001	Mann-Whitney-U
PFHxS, ng/mL	0.259 (0.155, 0.427)	0.616 (0.474, 1.000)	<0.001	Mann-Whitney-U
PFNA, ng/mL	0.179 (0.103, 0.199)	0.411 (0.293, 0.519)	<0.001	Mann-Whitney-U

**High-throughput lipidomics profiling:** The omics data were acquired under both the QTOF-only mode and the IM-QTOF mode. Major differential features include glycerophospholipids (GPs), sphingolipids (SPs), and fatty acyls (FAs).

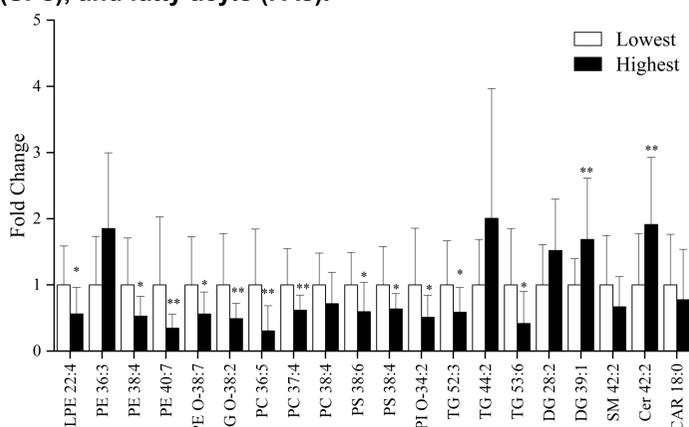


Figure 2. Relative changes of identified lipid biomarkers

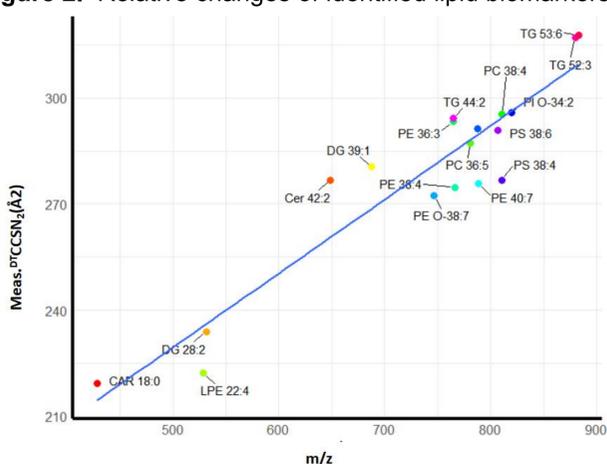


Figure 3. The measured CCS vs.  $m/z$  plot of identified lipid biomarkers

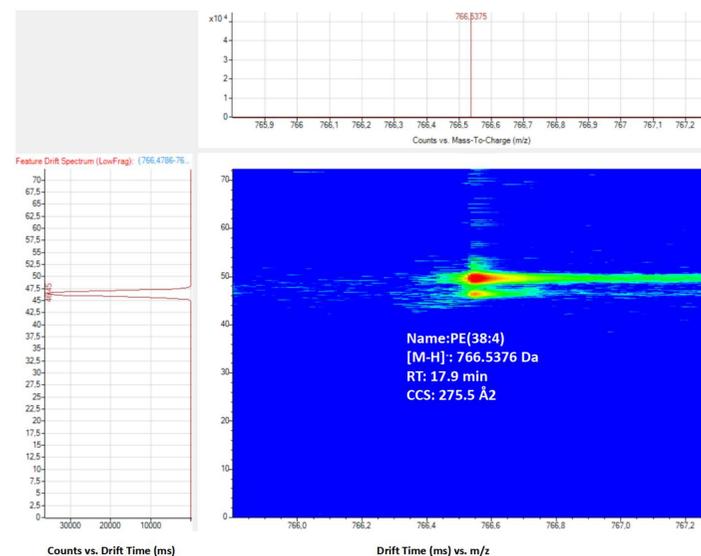


Figure 4. An illustration of 2D IM-MS spectrum for annotating lipids

**The disturbed glycerophospholipid, energy and sphingolipid metabolism: Insights from lipidomics characterization**

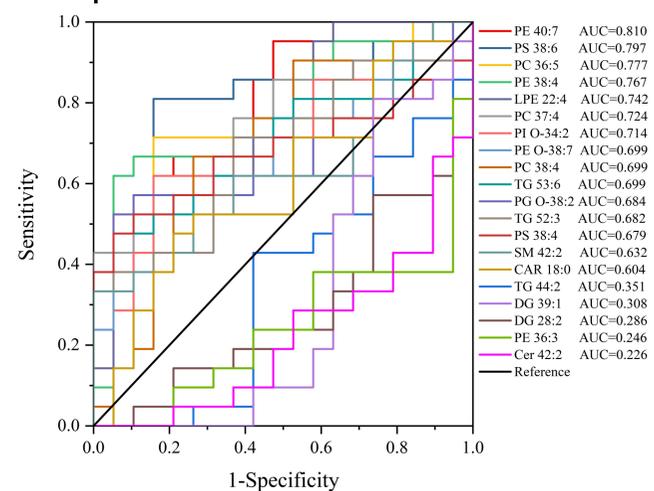


Figure 5. ROC curve analysis of the identified lipid biomarkers

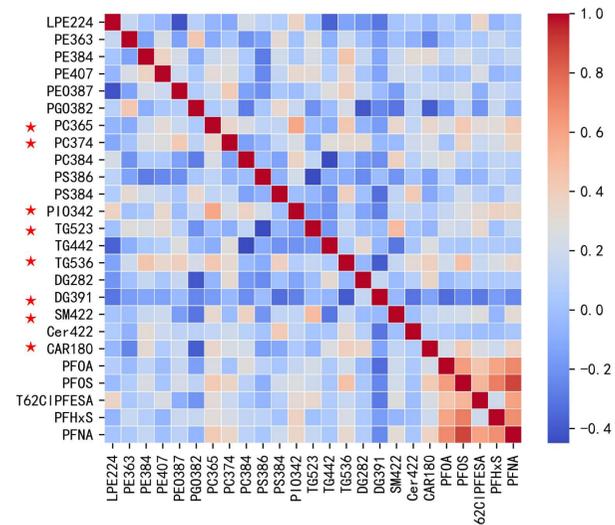


Figure 6. Spearman correlation matrix between the identified lipid biomarkers and the top five predominant PFASs

## CONCLUSIONS

- RPLC-DTIM-MS was utilized to characterize the serum lipidomics profile in a general population with residual PFAS for the first time.
- A total of 20 altered lipids including 6 classes of GPs (LPE, PE, PG, PC, PS, PI), 2 classes of SPs (Cer, SM), and 2 classes of FAs (TG, DG) with the integration of mass-to-charge ratio, retention time, collision cross section values and tandem mass spectra were summarized.
- These results indicate that the disturbed glycerophospholipid metabolism, energy metabolism and sphingolipid metabolism may be implicated in the general population exposed to PFAS. Also, PC 36:5, PC 37:4 and PI O-34:2 show both relatively high association and prediction with PFAS levels from the Spearman correlation and ROC curve analysis perspective.

## REFERENCES

- Kempisty, D. M.; Racz, L. Forever chemicals: environmental, economic, and social equity concerns with PFAS in the environment; CRC Press, 2021.

## ACKNOWLEDGMENTS

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