Table S1. Data available on the donors (n = 13) analyzed in the present study at the REST facility. The table presents personal, demographic, and medical information available for the donors included in this study. Dates are represented by dd/mm/yyyy.

Donor ID	Date & time of Death	Date & time of arrival at anatomy laboratory	Date & time of arrival at REST	Age	Sex	Weight (kg)	Height (cm)	BMI	Cause of Death
2	07/08/2020 at 12:00 pm	08/08/2020 11:18 am	10/08/2020	71	M	70	173	23.3	Hepatic cirrhosis, anuric renal insufficiency
6	10/05/2021 at 01:00 am	10/05/2021 at 4:30 pm	11/05/2021 at 11:00 am	77	M	79.5	177	25.2	Stage 4 Metastatic melanoma in lungs, brain, bones, muscles, kidneys, adrenal glands, and liver
9	30/07/2021 at 08:00 am	30/07/2021 at 9:30 am	01/08/2021 at 10:10 am	72	F	65.7	155	27.8	Malignant arrhythmia
10	30/09/2021 at 08:30 pm	01/10/2021 at 8:30 pm	02/10/2021 at 11:45am	78	M	56	185	16.3	Advanced lung neoplasia
11	11/10/2021 at 8:30 am	11/10/2021 at 5:00 pm	12/10/2021 at 11:00 am	54	M	44	163	16.5	Metastatic lung cancer
12	11/11/2021 at 11:32 am	11/11/2021 at 11:00 pm	12/11/2021 at 11:00 am	73	F	60	155	24.9	Lung neoplasia
13	12/04/2022 at 2:15 pm	12/04/2022 at 5:15 pm	13/04/2022 at 01:30 pm	86	M	63.5	173	21.2	Lung neoplasia
16	25/05/2022 at 06:40 am	26/05/2022 at 10:10 pm	27/05/2022 at 10:00	80	M	75	170	26	Thoracic-abdominal ruptured aneurysm, atherosclerotic disease, MCAS [Mass Cell Activation Syndrome], MVAS [atherosclerotic disease], atrial fibrillation, high blood pressure
17	14/06/2022	15/06/2022 at 08:00 pm	16/06/2022 at 10:30am	73	M	113	188	32	NA. Medically assisted death on 14/06/2022
22	02/05/2023 at 03:45 am	02/05/2023 at 12:30 pm	04/05/2023 at 12:00 pm	80	M	56.7	170	19.6	Lung neoplasia
23	19/06/2023 at 11:30 pm	20/06/2023 at 04:00 pm	21/06/2023 at 09:00 am	86	M	61.1	158	24	Geriatric cachexia following a stroke
24	29/07/2023 after 8:30 pm (last seen alive until then)	01/08/2023 at 9:00 am	01/08/2023 at 10:00 am	70	M	81	165	29	Asphyxiation due to hanging
25	24/08/2023 at 6:50 pm	24/08/2023 at 11:25 pm	25/08/2023 at 03:00 pm	75	M	67.3	175	22	Portal hypertension with ascites, hepatic encephalopathy, cirrhosis, high blood pressure
75	65.7	170	24						

Note S1: Matrix Application Using MedPro Compressor Nebulizer

A MedPro™ Compressor Nebulizer (AMG Medical Inc., QC, Canada) was adapted for use as a matrix sprayer and employed during both optimization and final analytical runs of MALDI-MS. The device operates using compressed air (35–45 psi) to produce aerosol droplets in the 0.5–5 µm range, with an airflow rate of 6–9 L/min. The nebulizer output was connected via flexible plastic tubing (~1 cm inner diameter) into a sealed polypropylene container (~3 L volume) containing the MALDI plate.

For each coating, approximately 6 mL of matrix solution was added to the nebulizer chamber. The unit was activated for 5 minutes, filling the container with a dense, fine mist. The matrix was then allowed to settle passively onto the plate for 15 minutes before removal and gentle drying under high-purity nitrogen gas for 10 minutes.

This passive deposition setup minimized airflow disturbances and allowed even aerosol distribution. Although originally designed for respiratory therapy, the nebulizer produced droplets of appropriate size and density to support stable matrix crystallization and consistent ionization performance across tissue sections. This setup offered an accessible and efficient alternative to commercial sprayers

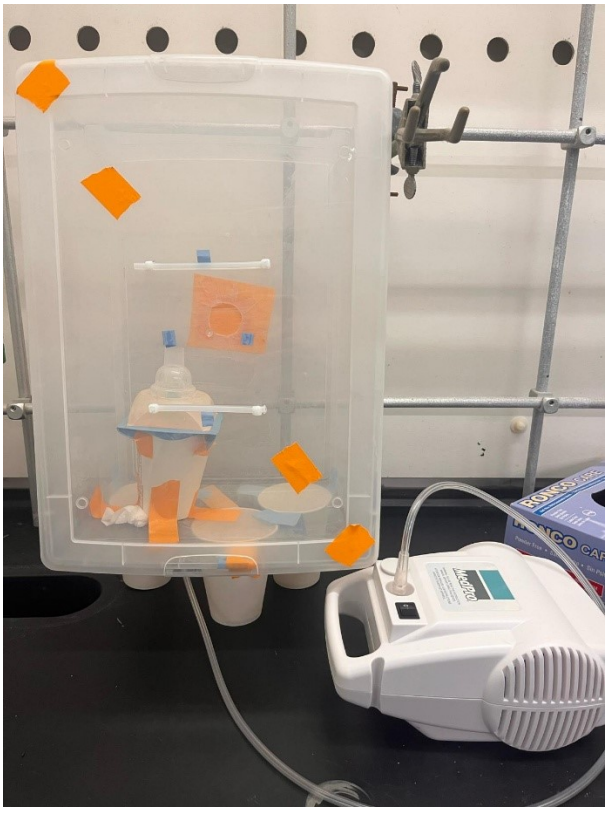

Fig. S1: Custom matrix sprayer setup used for application of MALDI matrix. A modified airtight plastic chamber was connected to a nebulizer compressor via tubing to create a controlled airflow system. Inside the chamber, matrix solution was nebulized allowing even coating of tissue samples placed below.

Table S2. Summary of compound class counts within each Van Krevelen region across all donors. These raw counts represent the number of molecular features assigned to each compound class category and were used as input variables for the principal component analysis (PCA).

Donor	Amino-sugars	Carbohydrates	Condensed Aromatics	Lignin	Lipids	Proteins/ Peptides	Unsaturated Hydrocarbons
2	59	122	308	382	104	302	76
6	18	35	102	140	69	134	34
9	68	177	260	505	267	593	113
10	72	151	287	571	107	471	99
11	25	50	106	209	72	218	32
12	76	159	402	530	146	371	121
13	27	57	133	189	62	151	42
16	27	77	186	304	113	255	62
17	34	94	164	269	88	320	46
22	664	962	1974	3864	754	2930	1335
23	555	971	2004	3303	552	2009	1026
24	436	689	1693	2385	436	1702	758
25	267	351	865	1387	299	1175	605

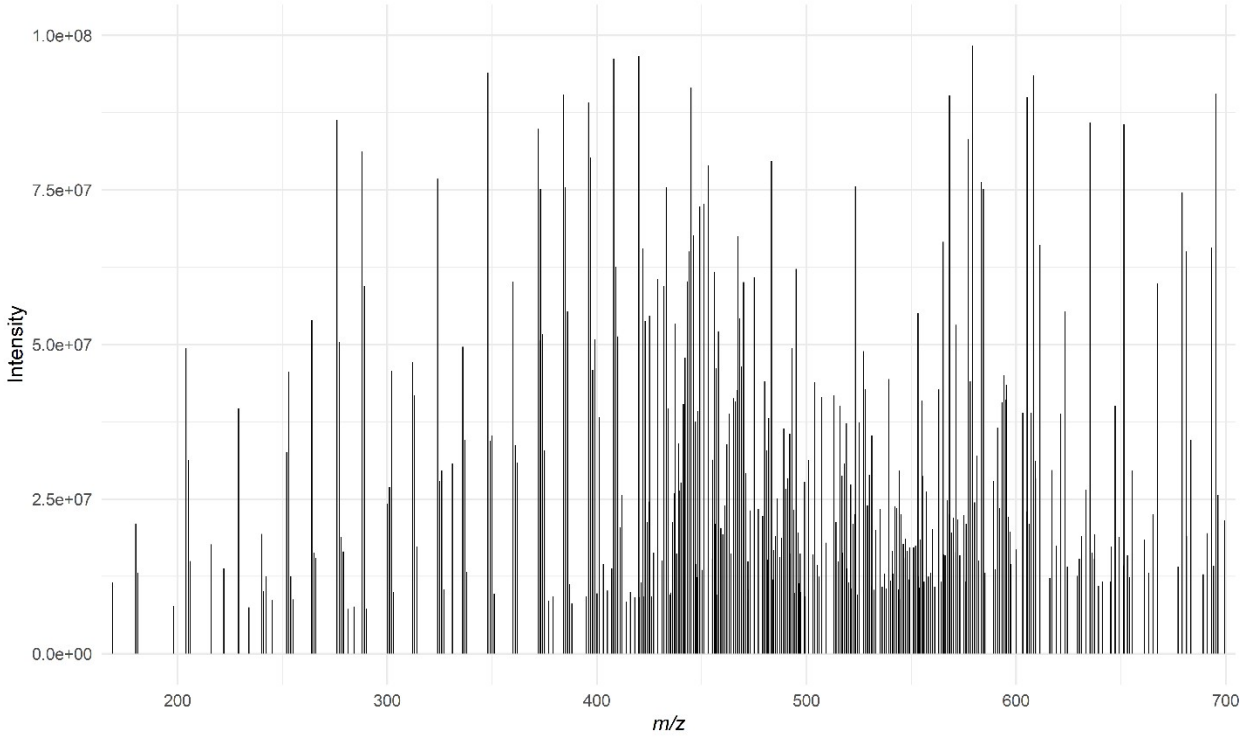

Fig. S2 Raw MALDI-MS spectrum (Donor 23, PMI 6)

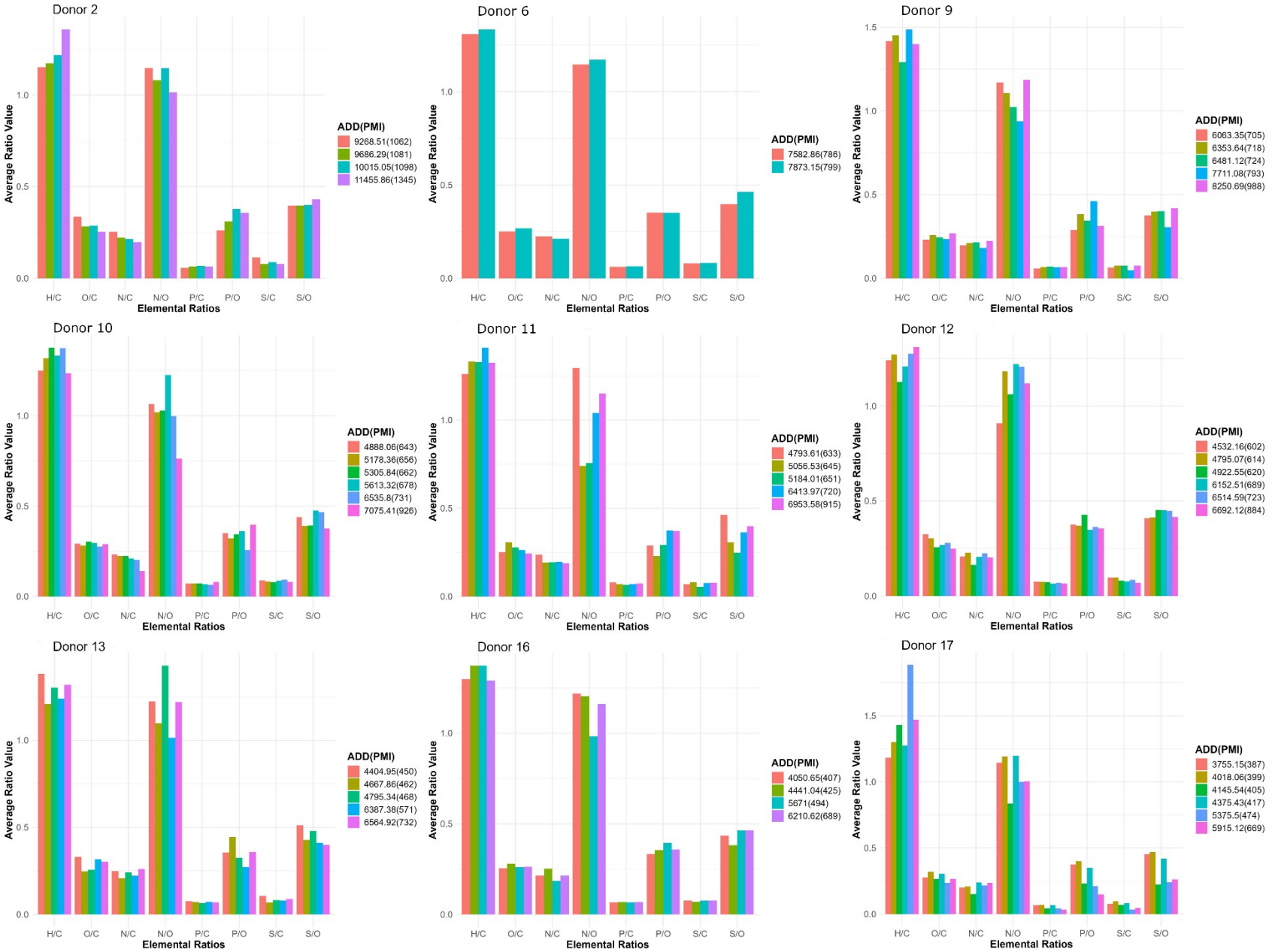

Fig. S3 Elemental ratios (H/C, O/C, N/C, N/O, P/C, P/O, S/C, and S/O) plotted as a function of PMI for Donor 2, 6, 9, 10, 11, 12, 16, 17. Bars represent the average ratio values calculated for each sampling event, color-coded according to the PMI (in days), and ADD. The plot highlights temporal changes in elemental composition, with distinct trends observed across the different ratios.

Table S3. Summary of linear regression model results for donors 22 to 25

Elemental Ratio	Donor	CI Low	CI High	R^2	Adjusted R^2	p value
H/C	22	-0.027	0.019	0.009	- 0.057	0.723
	23	-0.037	0.023	0.017	- 0.0582	0.639
	24	0.012	0.073	0.487	0.435	0.012
	25	-0.019	0.076	0.266	0.143	0.191
O/C	22	-0.011	0.005	0.045	- 0.019	0.415
	23	-0.013	0.001	0.226	0.167	0.073
	24	-0.016	-0.008	0.801	0.781	0.00008
	25	-0.005	0.014	0.159	0.019	0.328
N/C	22	-0.004	0.013	0.086	0.025	0.255
	23	0.002	0.031	0.324	0.272	0.027
	24	0.012	0.025	0.811	0.792	0.00006
	25	0.007	0.027	0.754	0.713	0.005
N/O	22	-0.001	0.058	0.222	0.170	0.056
	23	0.006	0.133	0.300	0.246	0.035
	24	0.081	0.149	0.849	0.834	0.00002
	25	0.009	0.071	0.624	0.561	0.020
S/O	22	-0.008	0.023	0.065	0.003	0.323
	23	0.005	0.042	0.370	0.321	0.016
	24	0.020	0.048	0.742	0.717	0.00032
	25	-0.004	0.033	0.395	0.295	0.095