Electronic Supplementary Material (ESI) for Environmental Science: Atmospheres.

Supplementary information for:

Aerosol emissions and their volatility from heating different cooking oils at multiple temperatures

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Table of contents:

shaded region represents standard error for n=5. The temperatures of the heated section are also shown in the legend. Note y-axis scale is different for each panel.

Figure S6. Soft ionization mass spectra for the C, H, O, and N containing ions in the extract obtained during the smoking of different frying oils. Panels a-d represent canola, lard, peanut, and soybean oil respectively.

Section S1: Temperature profile for the heating section of the thermodenuder

The temperature inside the center of the heating section of the thermal denuder (TD) was measured using a K-type thermocouple at different distances from the inlet to generate a temperature profile of the heating section is shown below as Figure S1.

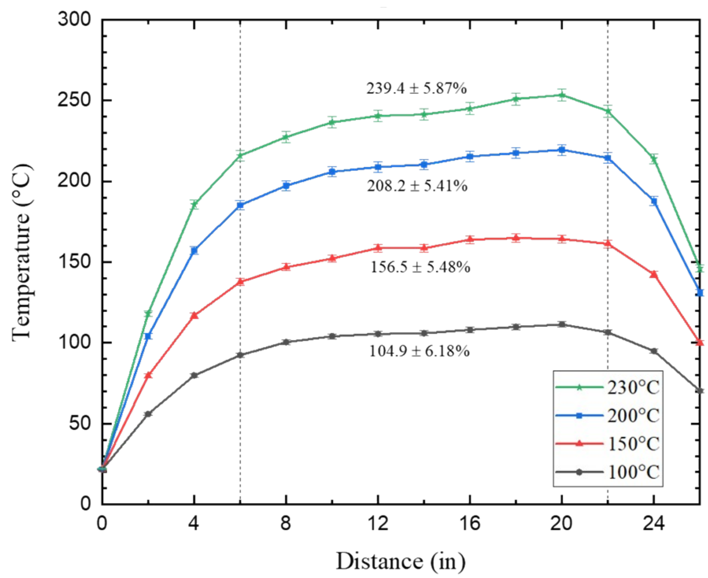

Figure S1. Temperature profile of the heating section as a function of distance from the inlet measured using a thermocouple, for different temperature setpoints.

After an initial increase in recorded temperatures for the first five inches of tube length from inlet, the temperatures started to stabilize for the majority of the tubing section. The average temperatures for lengths between 5-22 inches from the inlet remained within 10% of the set temperature. These results suggest that the TD heating section can provide steady temperatures and therefore can be used for studying the volatility characteristics of cooking oil generated emissions by observing changes in volume distributions over different TD temperatures.

Section S2: Sampling losses characterization for the sampling line and the thermodenuder system

The diffusion sampling losses for the SMPS line and the TD line for different particle sizes are shown in Figure S2. These losses were calculated using the "AeroCalc" spreadsheet containing equations from Hinds and Wilke and Barron.[1,2]

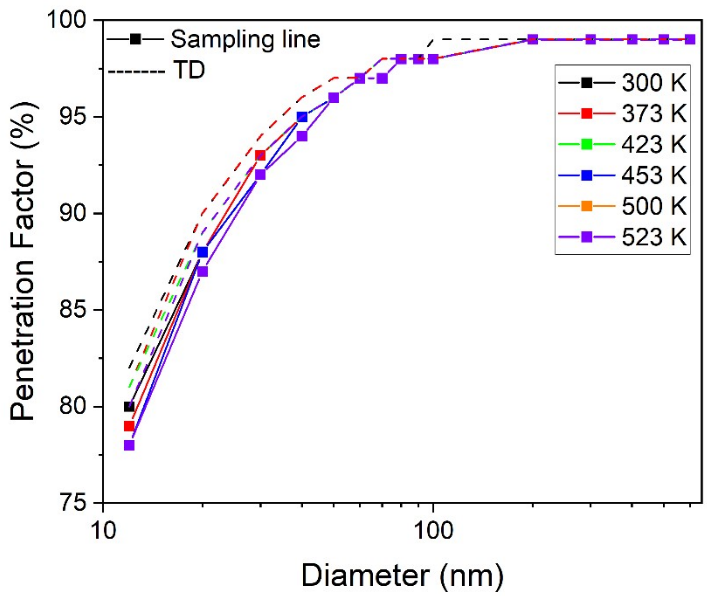

Figure S2. Penetration factor as a function of particle size calculated for the sampling line and the thermodenuder line.

For particle sizes greater than 40 nm, the penetration factor was greater than 95% for all the different temperatures used in the study. We would also like to acknowledge that in previous studies the theoretical models have been shown to overestimate the losses.[3–5] However, in our study since we have compared the aerosol size distributions for different oils using the same setup and the penetration factor remain largely unchanged with increase in temperature, we did not characterize the sampling loses further.

Table S1. Table showing total concentration and mode values for averaged size distributions obtained for heating a given oil at 180^{o}C.

Frying Oil	**Total Number Concentration ($\times 10^4$ cm^{-3})**	**Aerosol Number Distribution Mode (nm)**	**Total Mass Concentration (μg m^{-3})**	**Aerosol Mass Distribution Mode (nm)**
Lard	4.5	327.8	449.9	406.8
Coconut	6.6	50.5	59.1	283.9
Olive	3.1	128.6	163.8	352.3
Peanut	2.9	62.6	13.9	171.5
Soybean	2.5	89.8	32.8	228.8
Canola	4.9	58.3	29.7	184.3

Table S2. Parameters obtained from the FT-ICR analysis of the smoke sample of a given oil.

Frying Oil	**O/C ratio**	**H/C ratio**	**Number of carbon atoms**	**Average molecular mass (amu)**
Lard	0.15	1.9	38.9	629
Peanut	0.15	1.8	39.5	639
Soybean	0.17	1.9	37.9	620
Canola	0.16	1.8	37.8	619

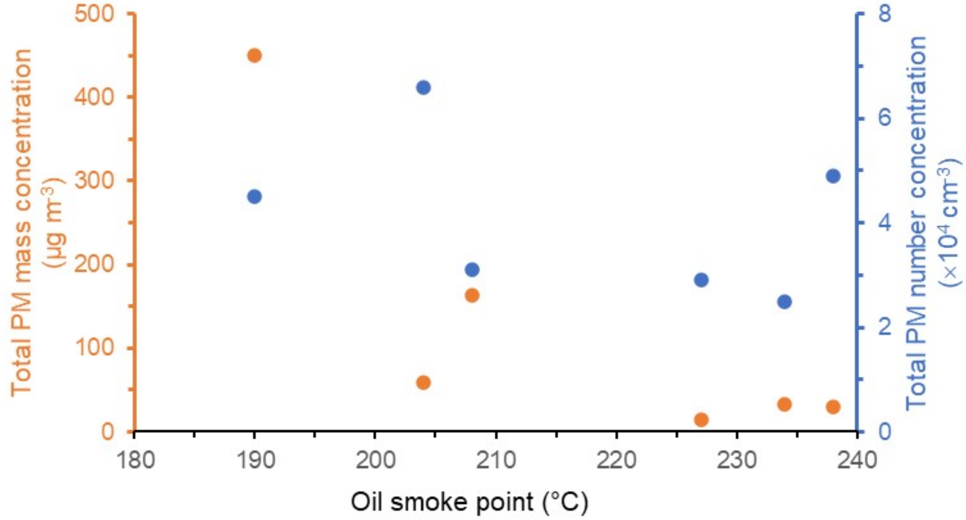

Figure S3. Aerosol mass and number concentrations as a function of oil smoke point. The smoke points of different oils in increasing order are as follows: Lard (190 ^{o}C), Coconut (204 ^{o}C), Olive (208 ^{o}C), Peanut (227 ^{o}C), Soybean (234 ^{o}C), and Canola (238 ^{o}C).

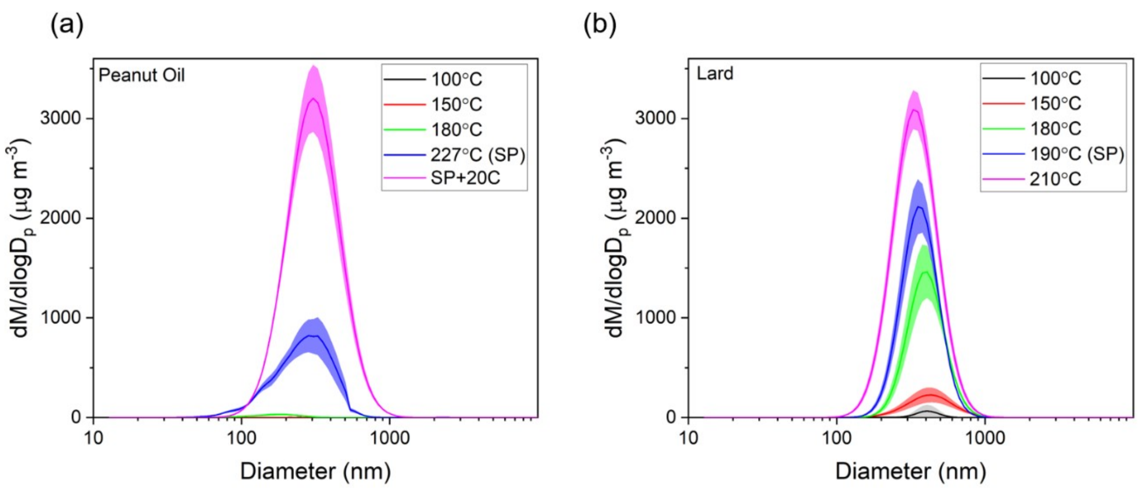

Figure S4. Aerosol mass distributions for peanut oil and lard over different cooking temperatures are shown in panels a and b respectively. The lines represent average values and the shaded region represents the standard error for n = 4.

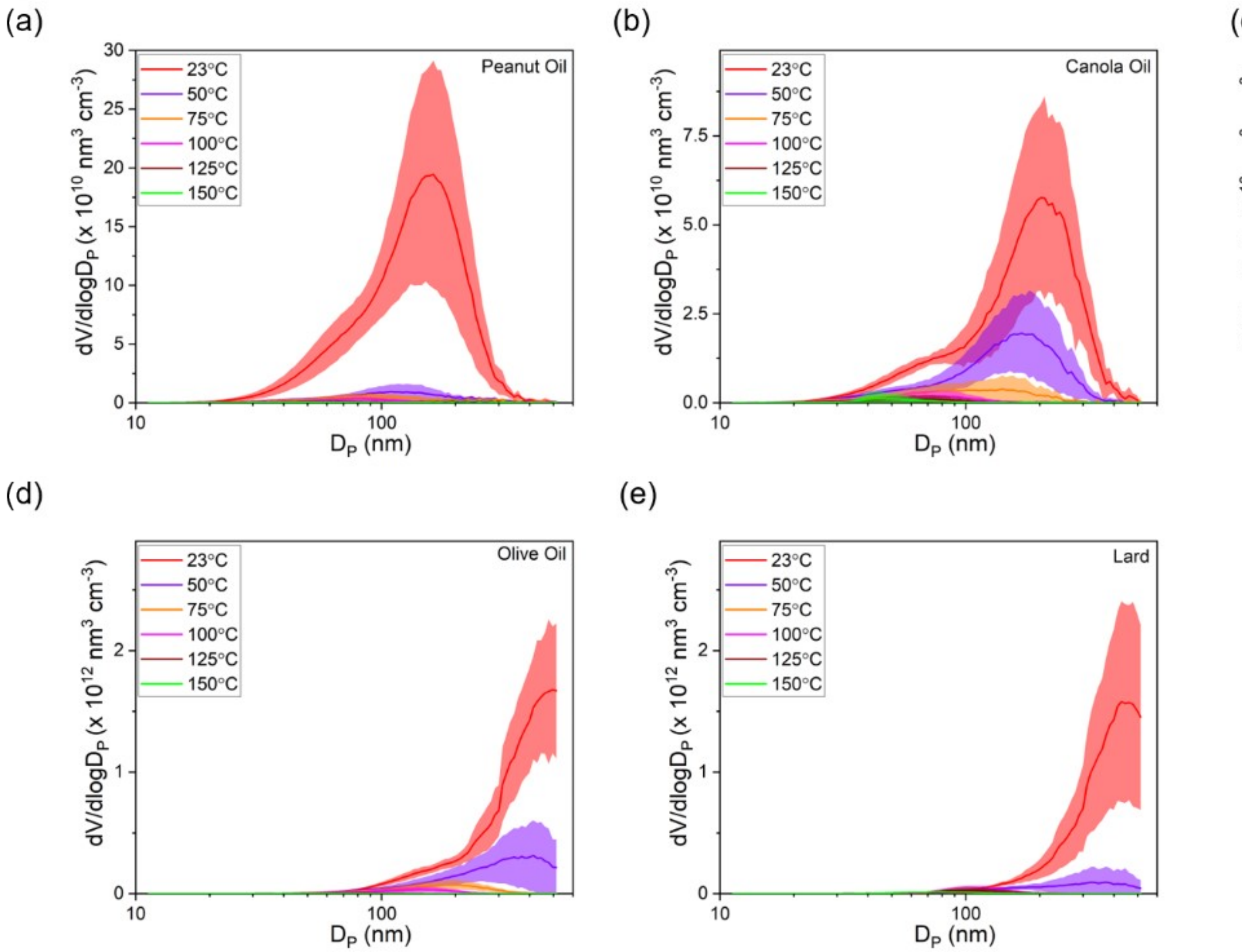

Figure S5. Aerosol volume distributions for different frying oils being heated at 180 °C after being thermally conditioned in a TD are shown in panels a-e. The lines represent average and the shaded region represents standard error for n=5. The temperatures of the heated section are also shown in the legend. Note y-axis scale is different for each panel.

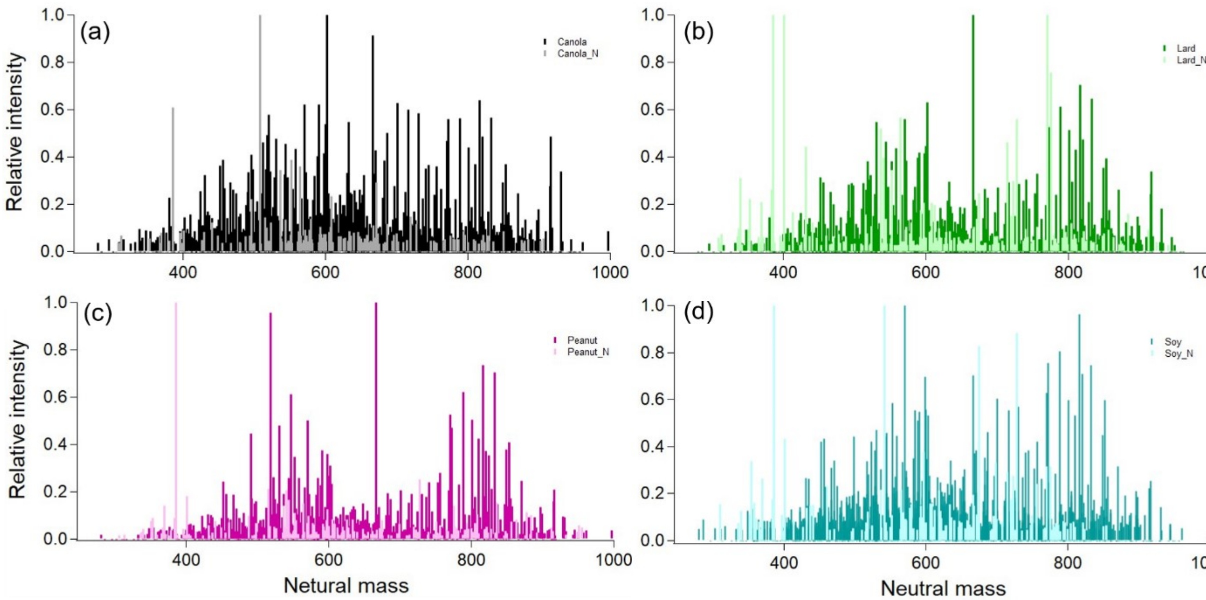

Figure S6. Soft ionization mass spectra for the C, H, O, and N containing ions in the extract obtained during the smoking of different frying oils. Panels a-d represent canola, lard, peanut, and soybean oil respectively.

References

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