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Interactive comment

Interactive comment on "Formation of secondary organic aerosols from gas-phase emissions of heated cooking oils" by Tengyu Liu et al.

Anonymous Referee #2

Received and published: 28 March 2017

General comments:

This work reports secondary organic aerosol (SOA) formation by OH radical oxidation of VOCs emitted from heated cooking oil using an oxidation flow reactor approach. Cooking emissions have been recognized as one of the major primary organic aerosol (POA) sources in urban environments. However, SOA formation potential of cooking emissions are largely unknown and hence this study is of great interest to the atmospheric community. Although the observations presented in this manuscript is qualitative due to their experimental limitations, this work clearly demonstrates SOA formation from cooking emissions that provide sufficient insight into future studies. The experiments are well performed in general but some clarifications are required, in particularly the relative importance of other oxidation chemistry in the flow tube reactor. The manuscript is well written and organized. I recommended this manuscript to be pub-



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lished in Atmospheric Chemistry and Physics after addressing the specific comments below:

Specific comments:

1. This manuscript focuses on discussing SOA production from OH radical oxidation chemistry. However, a recent modelling study by Peng et al. (2016) has illustrated potential significance of non-OH chemistry in oxidation flow reactors (OFR) for degradation of various SOA precursors. For example, some unsaturated VOCs such as monoterpenes might largely involve in the reaction with ozone depending on operating conditions of OFR. Since this manuscript demonstrates that mono- and poly-unsaturated fatty acids are important SOA precursors from heated cooking oils, it is necessary to comment on the relative importance of non-OH chemistry in the PAM reactor, especially for ozonolysis of unsaturated fatty acids, and how may this related to the observations reported in this manuscript. Control experiments of ozonolysis in the absence of OH radical may provide insight into this issue.

2. Line 88: What was the initial ozone concentration in the PAM reactor?

3. Line 111: Was the Teflon line heated and temperature controlled to minimize wall loss of VOCs? Please clarify.

4. Particle mass determination from SMPS data: Line 131: In general, particle effective density of SOA can be estimated by comparing SMPS data and particle time-of-flight (PToF) measurements from AMS in laboratory experiments. Did the authors conduct this type of estimation to validate their assumption? Furthermore, Figure 1 illustrates that aerosol particles were not dried before SMPS measurements. Please discuss uncertainties of SOA mass calculation due to the presence of aerosol water content.

5. Line 147: What was the collection efficiency (CE) for the SOA produced? Primary cooking organic aerosol is likely oil-like droplets that gives CE approximately equal to 1. Such information can provide insight into the viscosity of SOA produced from



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cooking emissions (i.e. particle bouncing on tungsten vaporizer increased with particle viscosity).

6. SOA production rate: I agree that it is reasonable to define SOA production rate as SOA mass produced per minute due to the experimental limitations (i.e. no VOC measurements). However, considering emission rates of VOCs from oils at a given temperature can be different, an additional SOA production rate defined as SOA mass produced per volume of oil evaporated may be able to reduce one experimental variable for interpreting the data (e.g. line 195-196). It is recommended to perform such calculation if the evaporation rate of oils were measured (i.e. volume change of heated cooking oils before and after heating).

7. Lines 213-216: What were the emission rate of POA from heated cooking oils? Please include this information (if available) in the comparison.

8. Lines 256-260: This argument is true if SOA is only a minor contributor to total COA mass because typical mass spectrum of COA factors have high m/z 41-to-m/z 43 ratios which are similar to the POA of heated cooking oil. Furthermore, typical diurnal patterns of COA show a strong peak during dinner time with extremely low OH radical concentration in the atmosphere. Of course, VOCs from cooking can react with other atmospheric oxidants but it is unclear if SOA produced by night time chemistry gives the similar mass spectrum.

References:

Peng, Z., Day, D. A., Ortega, A. M., Palm, B. B., Hu, W., Stark, H., Li, R., Tsigaridis, K., Brune, W. H., and Jimenez, J. L.: Non-OH chemistry in oxidation flow reactors for the study of atmospheric chemistry systematically examined by modeling, Atmos. Chem. Phys., 16, 4283-4305, doi:10.5194/acp-16-4283-2016, 2016.

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