

## Reviewer 2

This manuscript presents the analysis of N-containing aromatic compounds (NAC) in PM<sub>2.5</sub> samples collected from biomass-burning emissions of wood and charcoal in special household stoves. Prior to the HPLC analysis, the collected filters were spiked with one deuterated internal standard and extracted in methanol. The goal of this research was to estimate the contribution of BrC NAC species to the total absorption of PM<sub>2.5</sub> samples. The authors also discussed the differences (in OC, total NAC, individual NACs, etc.) between the hot-start and cold-start phases, and also between front and back filters. The authors acknowledged the limitations of this study (e.g., no gas-phase NACs were measured). This study is scientifically important, since NACs are not only light-absorbing compounds, but also are toxic organic species and they are still not well characterized. The manuscript is well organized and well written. I have a few major comments. In summary, I recommend this manuscript for publication after major revisions

### **Reply:**

Thanks for the reviewer's comments, and we'll reply these point by point in the reviewer's specific comments.

### **Major comments:**

1. The filter samples were spiked with only one deuterated I.S. compound (4-nitrophenol-d<sub>4</sub>, C6), while the analyzed NACs (Fig 1) have different volatility levels (C7-C11). The author should check if there were potential losses of I.S., which is more volatile than the rest of the analyzed species, and if these losses led to a large overestimates of the concentrations of the analyzed compounds.

### **Reply:**

In this study, the NACs in filter samples were determined identically as Xie et al. (2017, 2019). To minimize the evaporation loss, the sample extract volume was reduced using rotary evaporator under a vacuum, but not nitrogen blowdown evaporation. The coefficient of variation (CV) of the peak area for internal standard (IS) was only 0.16, indicating a stable IS signal. In addition, method recoveries were determined by spiking blank filters with known amounts of standard compounds, followed by extraction and quantification in the same way as that for collected samples. At the end of section 2.2, we mentioned that the average recoveries of NAC standards on pre-baked blank filters ranged from 75.1% to 116% (Lines 197-198). Therefore, the measurement results were not subject to uncertainties due to the loss of internal standard.

2. The manuscript contains a lot of abbreviations, which made it very hard to read (HS, CS, Qf, Qb, WBT, OMMs, SIM, etc.)

### **Reply:**

We have defined each abbreviation in the abstract and the rest of the text at the first instance, which satisfied the requirement of the journal.

3. Table 1. The concentrations of the total NACs are strikingly high for the backup filters. I am wondering if some sort of unexpected breakthrough happened during the

sampling (especially in the case of charcoal burning). Would it be possible that the BB emissions were quite hot during the sampling, which caused the evaporation from the front filter?

**Reply:**

The mass concentrations of OC and EC were measured for the same filter samples in our previous work (Xie et al., 2018). As no EC has been detected on backup filters ( $Q_b$ ), the breakthrough of particles was not expected during the sampling.

As shown in Table S2, filter samples were mostly collected at ambient temperature (~25 °C). We suspect that the identified NACs in this work have substantial fractions remaining in the gas phase (Lines 332-341).

In lines 344-347, we mentioned that the filter samples were mostly collected near ambient temperature.

*“Considering that most of the  $Q_f$  and  $Q_b$  samples were collected near ambient temperature (Table S2, ~25 °C), the composition of NACs derived from  $Q_f$  measurements alone can be biased due to the lack of gas-phase measurements.”*

4. Some minor comments Line 130. U.S. EPA – please make sure abbreviations are explained in the text Line 131: “USA” should be added after “NC” Line 126, what is “Jiko Poa”? Should company name be added? Lines 152, 156 etc. Company name (+city, state, country) of material and instruments is missing.

**Reply:**

In the revised manuscript, we defined US EPA before it first appeared (Lines 128-129).

“USA” was added after “NC” in line 130.

We added a brief description for all cookstoves, including “Jiko Poa”, in supplementary information (Text S1). The company and country names (BURN Manufacturing, Kenya) were added right after “Jiko Poa” (Line 141).

Company, state, and country were added for materials and instruments in lines 169-170, 173.

## References

- Xie, M., Chen, X., Hays, M. D., Lewandowski, M., Offenberg, J., Kleindienst, T. E., and Holder, A. L.: Light Absorption of Secondary Organic Aerosol: Composition and Contribution of Nitroaromatic Compounds, *Environmental Science & Technology*, 51, 11607-11616, 10.1021/acs.est.7b03263, 2017.
- Xie, M., Shen, G., Holder, A. L., Hays, M. D., and Jetter, J. J.: Light absorption of organic carbon emitted from burning wood, charcoal, and kerosene in household cookstoves, *Environmental Pollution*, 240, 60-67, <https://doi.org/10.1016/j.envpol.2018.04.085>, 2018.
- Xie, M., Chen, X., Hays, M. D., and Holder, A. L.: Composition and light absorption of N-containing aromatic compounds in organic aerosols from laboratory biomass burning, *Atmospheric Chemistry and Physics*, 19, 2899-2915, 10.5194/acp-19-2899-2019, 2019.