

Reviewer's comments on the PhD thesis**Ecotoxicological profiling of PM generated by urban heating and transport
by Tsend-Ayush Sainnokhoi**

Health and environmental problems caused by poor air quality is one of the most severe concerns of the modern urbanized societies besides climate change. Therefore, the topic of the thesis, determination of toxicity of atmospheric aerosol samples provides valuable contribution to the assessment and understanding of the environmental impact of APM pollution.

In his work, Tsend-Ayush Sainnokhoi study the toxicity of various particulate matter samples with *V. fischeri* bioluminescence inhibition essay using novel sample preparation methods. The ecotoxicity of the samples were studied in the context of their chemical composition (PAH content).

According to this, the topic of the thesis is timely, and relevant from both scientific and social point of view. The applied experimental methods are state-of-the-art and fit the purpose perfectly. The conclusions drawn from the results are correct.

The basis of the work is 5 publications in leading journals of the research field, which largely fulfills the requirement for a PhD dissertation of the Doctoral School of Chemistry and Environmental Sciences of the University of Pannonia.

The structure of the thesis is logical. The 113-page thesis is divided into four chapters after the Introduction and Objectives. Chapter 3 and 4 contains the literature review of particulate matter pollution and ecotoxicology, respectively. The applied methods are described in Chapters 5, and Chapter 6 contains the results and discussion in five subchapters. The work is completed by a summary, acknowledgements, and a bibliography. The figures and tables are clear, and helps the understanding well.

The candidate summarized the new scientific results in five thesis points, all of which I accept as new results.

Overall, the work presented in the thesis largely satisfies the requirements for a PhD dissertation, and the achieved results are also significant at the international level.

On the basis of the above, I recommend that the thesis be accepted and submitted for public discussion.

Debrecen, 2024. január 23.

A handwritten signature in blue ink, appearing to read 'Kertész Zsófia'.

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Dr. Kertész Zsófia
Senior researcher
HUN-REN ATOMKI

My further critical comments and questions on the thesis are as follows:

General comments:

Although the language of the thesis improved by a lot compared to the preliminary defense, there are still plenty of grammatical and linguistic errors, which sometimes makes it difficult to understand.

There are plenty of errors with the units (e.g. 5.3 Limit of detection: 0.001 μL , and the same in Tables 3 and 4., p.66: 290 mg/mg and 8.87 mg/m³, units in section 6.5.1: $\mu\text{g m}_3$, etc)

The results and discussion chapter is relatively short (38 pages) compared to the lengths of the literature review and the description of the methods. In addition, it goes into great detail on comparisons with the international literature data, while the presentation of own results is extremely concise. During the discussion in some cases, it was not even clear which research was referred to (own data or literature data). In my opinion, it would have been better if you had explained your own results in more detail.

Specific comments and questions:

Please clarify these statements:

- p.11 (wildfire): "Emissions are predominated by fine PM, which represent app. 92 % of the PM (Vicente *et al.*, 2017). In regions of Europe, the Fire Inventory from NCAR version 1.0 12 (FINNv1) estimated that coarse and fine PM annual average emission from open combustion were 0.39 Tg yr⁻¹ and 0.22 Tg yr⁻¹ (Wiedinmyer *et al.*, 2011)." These two statements contradict top each other.
- p.15: 15 "In addition, black carbon, mineral dust, and sea salt can be found in SIA." In the previous chapter (3.2) these were all described as primary aerosols.
- p. 17: "PAHs released from open-air combustion amounts to 61% of the total man-made air pollution".

What does biologically available and unavailable means in the following statement (p. 35): "First, such organic solvents are used in many cases which extract the whole toxic fraction of the sample, both biologically available and biologically unavailable."?

You say, that "Second, these solvents are not part of a natural exposure pathway" What solvents are? Which solvent represent best the natural systems? Which solvent do you think is the most suitable and why?

How do you explain the big difference between the toxicity of the water extract and the direct contact test? (ch. 6.1)

5.1.3 "The blank samples was also sampled for each type of waste combustion" Please explain, what is called blank sample in this case, and how was it sampled?

Is there an estimate of the possible contamination or loss of sample that could result from sample preparation for the direct contact test (e.g. grinding and transferring the sample)?

Figures 19 and 21: it is difficult to read the figures, color figures would have been better. The captions of Figures 21 and 22 are exchanged.

p.66 6.4.1 is the 8.87 mg/m³ concentration is correct? “Based on evidence reports on human health, antimony occurring in higher concentration than 8.87 mg/m³ seem to cause respiratory problems” Same question: p. 66. 6.4.2 “Total PAHs content of both PET waste samples varied in the samples and ranged from 290 mg/mg to 425 mg/kg.”

6.5.1. What do you think what caused the large differences in PM_{2.5} concentrations between households?

p. 75: what is the two numbers in the brackets in this sentence: “4-ring PAHs in indoor PM_{2.5} in each sample were abundant as well, in decreasing order: HH-5 (28%; 17.58%), HH-7 (21.71%; 6.42%), HH-8 (20.87%; 18.33%), HH-2 (18.75%; 8.57%)”?

6.5.5. I do not see the TU value of HH5 to be 5.5 in Figure 25. It is more near to 4 (“In HH-5, ratio of HMW PAHs amounted to 42.2%, TU was 5.5 respectively.”) In figure 8 of the publication (Sainnokhoi, TA., Kováts, N., Gelencsér, A. *et al.* Characteristics of particle-bound polycyclic aromatic hydrocarbons (PAHs) in indoor PM_{2.5} of households in the Southwest part of Ulaanbaatar capital, Mongolia. *Environ Monit Assess* **194**, 665 (2022). <https://doi.org/10.1007/s10661-022-10297-0>) and on Fig. 25 the TU values corresponding to the households HH1-HH10 differs significantly. What is the explanation to this? They should be the same.

6.5.5. The cluster analysis of only 10 samples is rather forced (normally much more samples are needed for such an analysis), and thus it yielded the result which was already known from the data. Therefore, I do not see the need for it.

6.5.5: Last sentence: “In our study, the kinetic diagram of indoor PM_{2.5} extracted samples of households were higher than typical curves of each control samples, however, these diagram of samples are regarded as far less toxic.” Please explain this statement. (e.g. less toxic than what?)