Reviewer 1:

Focusing on atmospheric microplastic pollution in the Guanzhong Plain of China, this paper investigates the characteristics of microplastics and plasticizers emitted from five typical sources of microplastics (plastic burning, fruit bag burning, road traffic, agricultural films, and animal husbandry) and their ecological health impacts, to provide a comprehensive perspective for a deeper understanding of atmospheric microplastic pollution. It is recommended that this manuscript be published with minor revisions.

Dear reviewer,

Thanks very much for taking your time to review this manuscript. We have carefully considered each of your suggestions and have made the necessary revisions to improve the quality of our manuscript. Below are our detailed responses to your comments:

1. Line 152: OBS and CBS all appear for the first time in the abstract, and it is recommended that the abbreviations be labelled on the first occurrence.

Response:

We have labeled the abbreviations in the abstract as requested. Additionally, we have ensured that these abbreviations are again defined at their first occurrence in the main text.

2. Line 175: note the font of the concentration units.

Response:

We have reviewed the concentration units and ensured that they are consistently formatted in the same font style throughout the manuscript.

3. Why choose BT, PAE, and BPA as plastic additives for in-depth research in this study?

Response:

The selection of BTs, PAEs, and BPA as the focus of our study is driven by their widespread use, ubiquitous in the environment and potential health risks.

Phthalate esters (PAEs) are the most widely used plasticizers globally, dominating the plastic additive market. He et al. (2020) demonstrated that during 2007-2017, the annual global production of PAEs increased from 2.7 million tons to 6 million tons. Moreover, China is recognized as the largest importer of PAEs worldwide. Benzothiazoles (BTs) are extensively used in automotive tires and agrochemicals. High concentrations of BTs were discovered in the street runoff, suggesting that these tire material-related compounds can persevere in the environment (Zhang et al., 2018). Exposure to BTs may result in central nervous system depression, liver and kidney damage, dermatitis, and pulmonary irritation (Ginsberg et al., 2011). Bisphenol A (BPA) as a common industrial chemical component in many products, has steadily grown over the last 50 years (Corrales et al., 2015). Growth of global production has consistently ranged between 0% and 5% annually (Corrales et al., 2015). PAEs and BPA considered as endocrine disruptors, are demonstrated to impair reproductive function and development in laboratory animals (Wang et al., 2018).

Despite the well-documented health risks associated with these plasticizers in laboratory settings, there is a significant gap in understanding their real-world emissions and health impacts. In this study, we aim to fill this gap by investigating the emission characteristics of these plasticizers from various sources and evaluating their potential health impacts based on real-world

concentration levels.

The related sentences have been revised as follows.

"Plasticizers are widely used in the production of plastics in order to achieve the desired material properties (Demir and Ulutan, 2013). Since plasticizers are not chemically bound to the plastic products, they can easily diffuse into the surrounding environment during the life-time (Yadav et al., 2017; Demir and Ulutan, 2013). PAEs, BTs, and BPA are the most common plastic additives that are ubiquitous in the environment and pose potential health risks. Phthalate esters (PAEs) are the most widely used plasticizers globally, dominating the plastic additive market. He et al. (2020) demonstrated that during 2007-2017, the annual global production of PAEs increased from 2.7 million tons to 6 million tons. China is recognized as the largest importer of PAEs worldwide. Benzothiazoles (BTs) are extensively used in automotive tires and agrochemicals. High concentrations of BTs were discovered in the street runoff, suggesting that these tire material-related compounds can persevere in the environment (Zhang et al., 2018). Exposure to BTs may result in central nervous system depression, liver and kidney damage, dermatitis, and pulmonary irritation (Ginsberg et al., 2011). Bisphenol A (BPA) as a common industrial chemical component in many products, has steadily grown over the last 50 years (Corrales et al., 2015). Growth of global production has consistently ranged between 0% and 5% annually (Corrales et al., 2015). PAEs and BPA considered as endocrine disruptors, are demonstrated to impair reproductive function and development in laboratory animals (Wang et al., 2019).

Previous studies have investigated the emission characteristics of plasticizers from various sources. Simoneit et al. (2005) illustrated that the major plasticizers detected in particulate matters (PMs) from open-burning of plastics were dibutyl phthalate (DBP), diethylhexyl adipate (DEHA), and diethylhexyl phthalate (DEHP). Zeng et al. (2020) reported phthalate concentrations in greenhouses air were higher than that in ambient air. Liu et al. (2023) found that phthalates were the most dominant plasticizer compositions in tunnel $PM_{2.5}$, accounting for 64.8% of the detected plasticizers. Zhang et al. (2018) demonstrated that tire material-related compounds, benzothiazole (BT) and 2-hydroxybenzothiazole (2-OH-BT) were the major compounds in both tire and road dust samples. The majority of existing studies on atmospheric MPs and plasticizers have focused on analyzing the emission characteristics of individual source and lacked a comprehensive and comparative analysis of the MPs emission profiles of various sources."

Reference:

Corrales, J., Kristofco, L. A., Steele, W. B., Yates, B. S., Breed, C. S., Williams, E. S., and Brooks, B. W.: Global Assessment of Bisphenol A in the Environment: Review and Analysis of Its Occurrence and Bioaccumulation, Dose-Response, 13, 29, 10.1177/1559325815598308, 2015.

Demir, A. P. T. and Ulutan, S.: Migration of phthalate and non-phthalate plasticizers out of plasticized PVC films into air, Journal of Applied Polymer Science, 128, 1948-1961, 10.1002/app.38291, 2013.

Ginsberg, G., Toal, B., and Kurland, T.: Benzothiazole Toxicity Assessment In Support Of Synthetic Turf Field Human Health Risk Assessment, J. Toxicol. Env. Health Part A, 74, 1175-1183, 10.1080/15287394.2011.586943, 2011.

He, M. J., Lu, J. F., Wang, J., Wei, S. Q., and Hageman, K. J.: Phthalate esters in biota, air and

water in an agricultural area of western China, with emphasis on bioaccumulation and human exposure, Sci. Total Environ., 698, 9, 10.1016/j.scitotenv.2019.134264, 2020.

Liu, M. X., Xu, H. M., Feng, R., Gu, Y. X., Bai, Y. L., Zhang, N. N., Wang, Q. Y., Ho, S. S. H., Qu, L. L., Shen, Z. X., and Cao, J. J.: Chemical composition and potential health risks of tire and road wear microplastics from light-duty vehicles in an urban tunnel in China, Environmental Pollution, 330, 9, 10.1016/j.envpol.2023.121835, 2023.

Simoneit, B. R. T., Medeiros, P. M., and Didyk, B. M.: Combustion products of plastics as indicators for refuse burning in the atmosphere, Environ. Sci. Technol., 39, 6961-6970, 10.1021/es050767x, 2005.

Wang, Y., Zhu, H. K., and Kannan, K.: A Review of Biomonitoring of Phthalate Exposures, Toxics, 7, 28, 10.3390/toxics7020021, 2019.

Yadav, I. C., Devi, N. L., Zhong, G., Li, J., Zhang, G., and Covaci, A.: Occurrence and fate of organophosphate ester flame retardants and plasticizers in indoor air and dust of Nepal: Implication for human exposure, Environmental Pollution, 229, 668-678, 10.1016/j.envpol.2017.06.089, 2017.

Zeng, L.-J., Huang, Y.-H., Chen, X.-T., Chen, X.-H., Mo, C.-H., Feng, Y.-X., Lu, H., Xiang, L., Li, Y.-W., Li, H., Cai, Q.-Y., and Wong, M.-H.: Prevalent phthalates in air-soil-vegetable systems of plastic greenhouses in a subtropical city and health risk assessments, Sci. Total Environ., 743, 10.1016/j.scitotenv.2020.140755, 2020.

Zhang, J., Zhang, X., Wu, L., Wang, T., Zhao, J., Zhang, Y., Men, Z., and Mao, H.: Occurrence of benzothiazole and its derivates in tire wear, road dust, and roadside soil, Chemosphere, 201, 310-317, 10.1016/j.chemosphere.2018.03.007, 2018.

Zhang, H., Yang, R. F., Shi, W. Y., Zhou, X., and Sun, S. J.: The association between bisphenol A exposure and oxidative damage in rats/mice: A systematic review and meta-analysis, Environmental Pollution, 292, 9, 10.1016/j.envpol.2021.118444, 2022.

4. Please supplement QAQC in the Methods section for the analysis of DTT, need to know the accuracy and precision of the analysis.

Response:

Thank you for your suggestion. We have supplemented the Methods section with the following detailed information:

"To ensure the accuracy of the results, the entire experiment was performed under dark conditions. Prior to sample analysis, a standard curve was generated by measuring the absorbance of 11 DTT concentration gradients within the range of 0 to 450 μmol L^{-1}, achieving a correlation coefficient (R^2) of 0.9997. Pure methanol solution was used as a blank control, which was processed and measured in the same manner as the samples. The DTT consumption rate of each sample was corrected using the DTT consumption rate of the blank. Each batch of samples and methanol blanks was measured in duplicate to verify experimental reproducibility. The linear fitting R^2 for DTT consumption rates was consistently greater than 0.9, and the coefficient of variation (standard deviation) for parallel experiments was less than 15%."

5. How is the Source Pathway Decoder model developed? Is there an operation based on some data? Input of basic information? Or is it just a conceptual model? What is the main purpose in this study?

Response:

The Source Pathway Receptor model was developed based on methodologies described in the systematic review by Velis et al. (2021) titled "Mismanagement of Plastic Waste through Open Burning with Emphasis on the Global South: A Systematic Review of Risks to Occupational and Public Health". It is just a conceptual model. This model systematically evaluates the environmental consequences of MPs and plasticizers from different sources and their inter-relationships. Based on the emission concentrations and potential pathways of MPs and plasticizers from typical sources, studies can be conducted to assess the effects of MPs and plasticizers to human health at environmentally relevant concentrations in the future.

Reference:

Velis, C. A. and Cook, E.: Mismanagement of Plastic Waste through Open Burning with Emphasis on the Global South: A Systematic Review of Risks to Occupational and Public Health, Environ. Sci. Technol., 55, 7186-7207, 10.1021/acs.est.0c08536, 2021.

6. Lines 210 and 429: It is suggested that there should be consistency throughout the text as to whether P should be capitalized or lower case.

Response:

We have revised the text to ensure consistent capitalization by using uppercase "P" throughout the manuscript.

7. Line 296: It is recommended that further discussion of the reasons why the results in this study are contrary to other studies.

Response:

Thank you for your suggestion. We have added a more detailed discussion in the revised manuscript.

"Furthermore, BTs, PAEs, and BPA from sources except for PB were prevalent in $PM_{2.5}$ relative to $PM_{2.5-10}$, contrary to the results reported by Nunez et al. (2020). This discrepancy may be attributed to differences in pollution sources. Nunez et al. (2020) demonstrated that port industrial activities (e.g., cargo handling and industrial emissions) predominantly generated coarse PM, resulting in higher concentrations of plasticizers in this fraction. In contrast, high temperature in PB promoted the formation of fine particles with larger surface area enhancing the adsorption of plasticizers."

Reference:

Nunez, A., Vallecillos, L., Maria Marce, R., and Borrull, F.: Occurrence and risk assessment of benzothiazole, benzotriazole and benzenesulfonamide derivatives in airborne particulate matter from an industrial area in Spain, Sci. Total Environ., 708, 10.1016/j.scitotenv.2019.135065, 2020.

8. Line 438: It is recommended that an outlook for future research be included. For example, there may be a variety of other MPs in the environment that were not detected in this study, which may pose a risk, and it is recommended that the need to expand the range of substances assessed be mentioned in the outlook for future studies to improve the health risk assessment system.

Response:

We sincerely appreciate the reviewer's valuable suggestion. We have revised the conclusion section to provide a more comprehensive outlook for future studies.

"Future studies should expand the range of assessed MPs and plasticizers and integrating multiple ecological health assessment methods to further refine the health risk assessment system and deepen the understanding of the environmental and health hazards of MPs."

9. Line 584: note the format of references.

Response:

The reference format has been carefully checked and revised to ensure consistency with the journal's guidelines.

10. You can add this newly reference: The hidden threat of microplastics in the bloodstream. The Innovation Life 3:10013

Response:

The authors have added the reference in Line 107 of revised manuscript. This reference elucidates the potential health risks of MPs when they enter the human bloodstream. These findings support our discussion on the potential health hazards of microplastics in our research.