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ABSTRACT

Fine particles smaller than 2.5 micrometers (PM_{2.5}) are a significant air pollutant in Northern Thailand, often containing carcinogenic polycyclic aromatic hydrocarbons (PAHs) produced by incomplete combustion. This study aims to measure PM_{2.5} concentrations and evaluates the health risks associated with PM_{2.5}-bound PAHs in Nan province during smoke haze (SH) and non-smoke haze (NSH) seasons of 2024. PM_{2.5} samples (24 hours) were collected at three sites in Nan. Concentrations were significantly higher during the SH season, with the highest levels observed at BN (76.54 µg/m³), followed by ML (73.05 µg/m³) and KN (72.45 µg/m³). Total PAH concentrations during SH were 1.776 ng/m³ in BN, 1.633 ng/m³ in ML, and 0.745 ng/m³ in KN. Carcinogenic PAHs (cPAHs) were consistently higher than non-carcinogenic PAHs (ncPAHs), with the highest cPAHs concentration recorded in BN (1.453 ng/m³). These findings highlight the severe impact of biomass burning on air quality and public health, particularly during the SH season. Given the elevated levels of carcinogenic PAHs, immediate action is crucial to control biomass burning and implement effective air quality management strategies to mitigate health risks.

INTRODUCTION

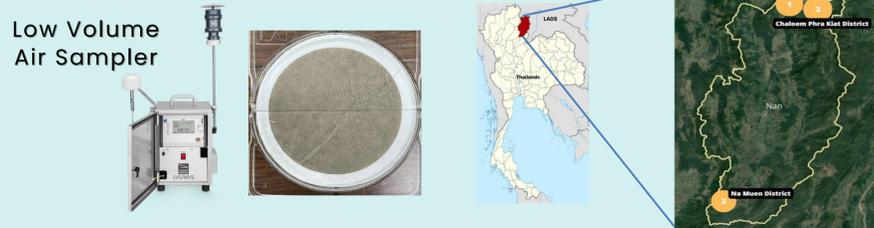
Nan is one of the northern provinces of Thailand and has been affected by PM_{2.5} air pollution for a long time. PM_{2.5} often contains contamination of Polycyclic aromatic hydrocarbons (PAHs) or carcinogens. Therefore, this research analyzed PAHs samples from PM_{2.5} samples. PAHs are hydrocarbon compounds that have two or more benzene rings. PAHs are produced by incomplete combustion of organic matter, such as vehicle emission, transportation, biomass burning, and smoking, etc. PAHs can have both short-term and long-term effects on human health, with the most significant and severe impact being an increased risk of cancer.

METHODOLOGY

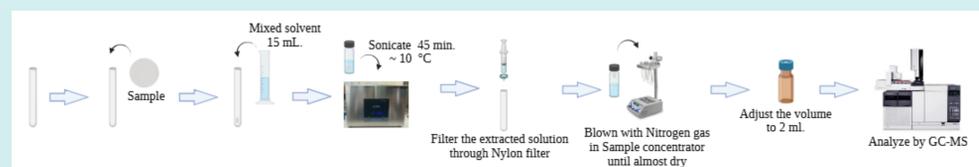
- 1. Sampling sites**
- Ban Nam Liang School, Thung Chang District
 - Ban Kiew Chan School, Chaloeam Phra Kiat District
 - Muang Li Kindergarten School, Na Muen District

Duration: Smoke haze seasons (March - May 2024) and Non-Smoke haze seasons (November 2024 - January 2025)

- 54 Samples/Seasons. Total 108 Samples in project.



2. Extraction method and PAHs analysis



3. Analyze Health Risks Assessment

by Toxic equivalency concentration (TEQ) and Inhalation cancer risk (ICR)

$$TEQ = \sum_i (C_i \times TEQ_i)$$

$$ICR = TEQ \times IUR_{BbP}$$

Toxic Equivalency Concentration (TEQ) is used for risk assessment in environmental and health studies.

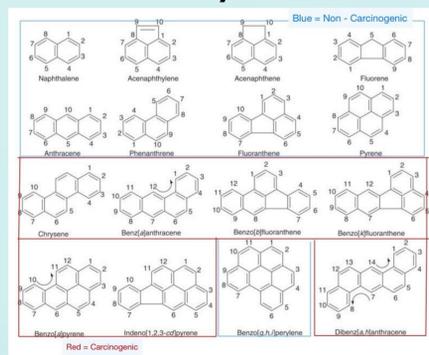
Inhalation Cancer Risk (ICR) estimates the probability of developing cancer due to long-term exposure to airborne carcinogens, based on pollutant concentration and toxicity factors.

$$ICR < 1 \times 10^{-6} = \text{Low risk}$$

$$ICR 1 \times 10^{-6} \text{ to } 1 \times 10^{-4} = \text{Medium risk}$$

$$ICR > 1 \times 10^{-4} = \text{High risk}$$

Chemical structure of 16 PAHs by US-EPA



RESULT & DISCUSSIONS

1. PM_{2.5} and PAHs concentration

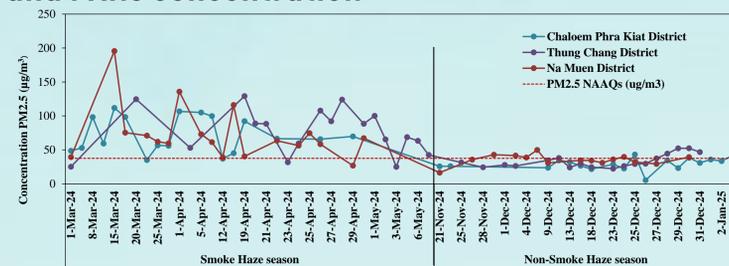


Fig. 1 PM_{2.5} concentrations during Smoke haze and Non-smoke haze seasons

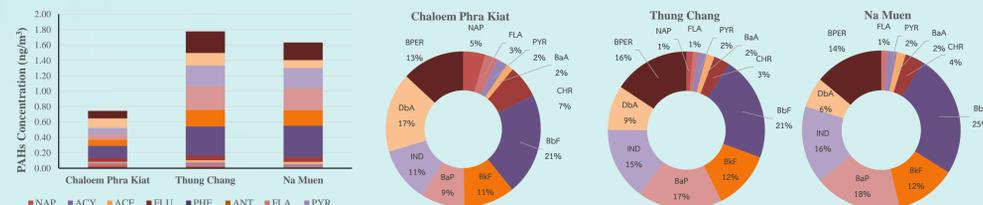


Fig. 2 Total PAHs concentration and percentage contribution of PAHs during Smoke haze season

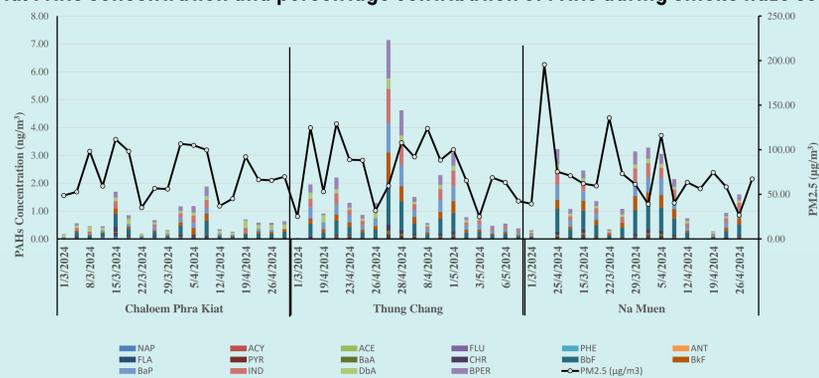


Fig. 3 Daily PAHs concentrations

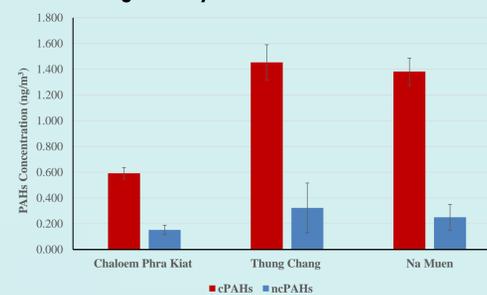


Fig. 4 Average concentration of the carcinogenic and non-carcinogenic

2. Health risk assessment

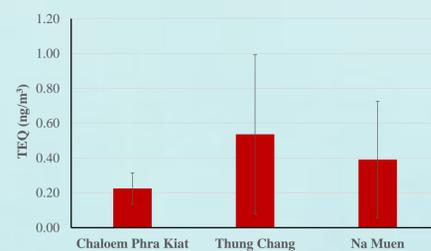


Fig. 5 Average of TEQ concentration

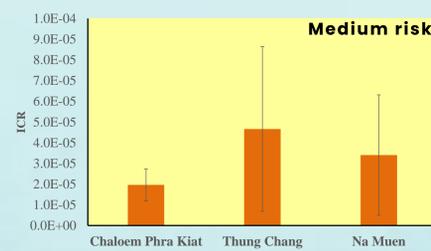


Fig. 6 Average of ICR concentration

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- Department of Chemistry Chiang Mai University
- Chiang Mai University

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CONCLUSION

- Average PM_{2.5} concentrations was found in the smoke haze season.
- High PAHs concentrations was found in Thung Chang.
- Carcinogenic PAHs (cPAHs) were consistently higher than non-carcinogenic PAHs (ncPAHs) across all sampling sites.
- BbF and BaP (cPAHs) were dominant at all locations, indicating combustion sources.
- Thung Chang had the highest TEQ concentration (0.5360 ng/m³), followed by Na Muen (0.3912 ng/m³) and Chaloeam Phra Kiat (0.2254 ng/m³).
- Based on the ICR values, it was found that all sampling sites had a medium risk of cancer.