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ABSTRACT

Air pollution is a significant environmental issue that impacts public health, especially during the smoke haze period, which typically occurs between February and April each year in Chiang Mai. PM_{0.49} had an aerodynamic diameter equal to or smaller than 0.49 μm and accounted for 60% of PM_{2.5}. Due to its small size, PM_{0.49} can penetrate the bloodstream and vital organs more easily, potentially posing even greater health risks. This study aims to determine the oxidative potential (OP) of PM_{0.49} collected during smoke-haze and non-smoke haze periods in the urban Chiang Mai in 2024. PM_{0.49} samples were collected during February to June 2024 for 24 hours using a high-volume air sampler with a 5-stage cascade impactor, operating at an airflow rate of 1,000 L/min, at the Northern Meteorological Center, Chiang Mai, Thailand. The result shows concentrations of PM_{0.49}, OP_v, OP_m across periods. A study shows a low correlation (R² = 0.403) between PM_{0.49} concentration and OP_m value. Because a OP_m value depends on the mass of particles and Coarse particles cannot penetrate in our body as a fine particles. During the smoke-haze period, both PM_{0.49} concentration and OP_v were relatively higher compared to the pre- and post-smoke haze periods and shows a strong correlation (R² = 0.8187), suggesting that poor air quality during the smoke-haze periods may lead to higher level of oxidative stress and increase potential health risk.

INTRODUCTION

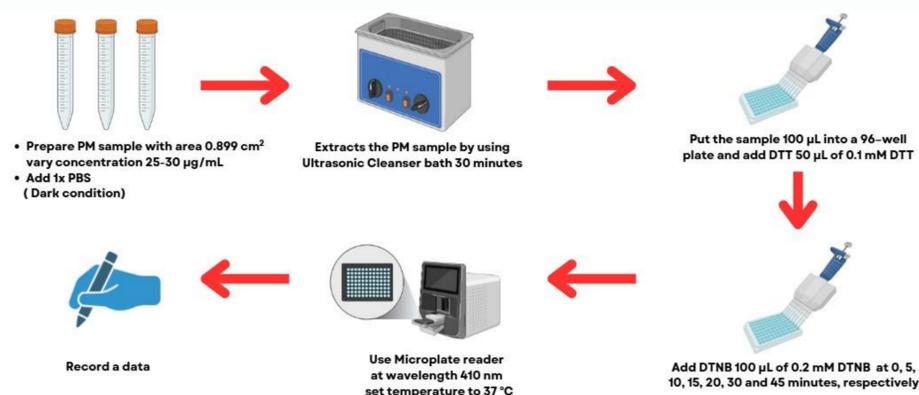
Particulate matter (PM) comprises a complex mixture of airborne particles with diverse chemical compositions. While commonly recognized fractions include PM₁₀ and PM_{2.5}, this study focuses specifically on PM_{0.49}, as it constitutes more than 60% of PM_{2.5} and possesses the capability to penetrate deep into the respiratory system and enter the bloodstream. The oxidative potential (OP) of PM serves as a critical indicator of its ability to generate reactive oxygen species (ROS) (A.K Cho et al 2005), which are key contributors to cellular and tissue damage, ultimately leading to oxidative stress.

METHODOLOGY

1.) Sampling sites and size-fractionated particulate matter (SPM) samples



2.) Oxidative potential (OP) by DTT assay method



3.) Calculation

The DTT activity was calculated as :

$$OP_v = \frac{\Delta DTT}{V_{air}(m^3)}$$

$$OP_m = \frac{\Delta DTT}{M_{particle}(mg)}$$

The consumption rate of DTT (ADTT) was calculated as follows:

$$\Delta DTT = -\sigma Abs \frac{N_{DTT}(nmol)}{Abs}$$

OP_v = Estimate the exposure dosage based on total in halation air volume (Extrinsic). (μmol/min/m³)
OP_m = The potency of unit PM's toxicity (Intrinsic). (μmol/min/μg)
ADTT = Rate of DTT consumption rate of DTT consumption due to collected particles (μmol/min).
V_{air} = Sampling air volume (m³).
M_{particles} = Mass of sampling particles.

-σAbs = Slope of absorbance versus time.
σAbs = The Inital absorbance estimated from the intercept of linear regression of absorbance versus time.
N_{DTT} = The initial mole

RESULT

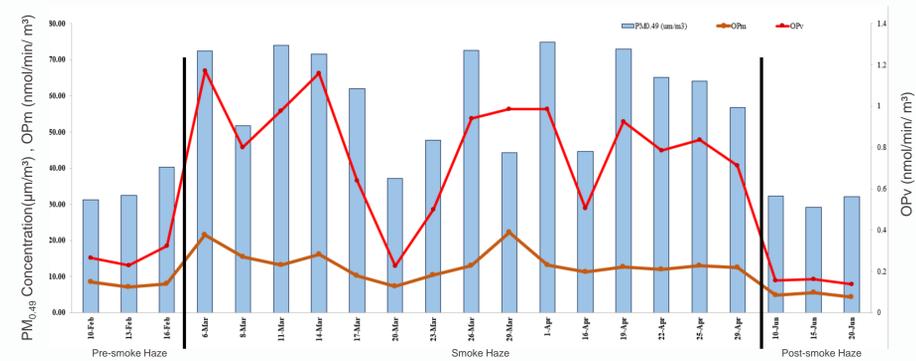


Figure 1: Relationship between PM_{0.49} concentration with OP_v and OP_m in each period

Average and standard concentration of OP_m, OP_v and PM_{0.49} during across period Pre-smoke Haze (Pre-SH), Smoke Haze (SH), Post-smoke Haze (Post-SH)

Pre-SH	Avg ± SD	SH	Avg ± SD	Post-SH	Avg ± SD
OP _v (nmol/min/m ³)	0.265 ± 0.048	OP _v (nmol/min/m ³)	0.836 ± 0.259	OP _v (nmol/min/m ³)	0.156 ± 0.014
OP _m (nmol/min/m ³)	8.037 ± 0.741	OP _m (nmol/min/m ³)	13.000 ± 3.943	OP _m (nmol/min/m ³)	4.838 ± 0.667
PM _{0.49} (μg/m ³)	32.48 ± 4.952	PM _{0.49} (μg/m ³)	64.08 ± 12.792	PM _{0.49} (μg/m ³)	32.19 ± 1.763

Correlation between PM_{0.49} concentration, OP_m and OP_v :

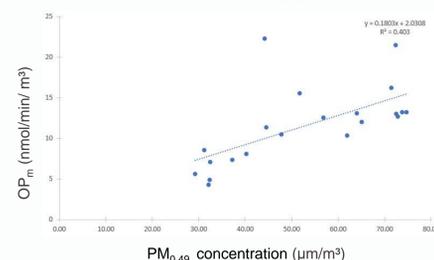


Figure 2: R-squared (R²) correlation between PM_{0.49} concentration and OP_m

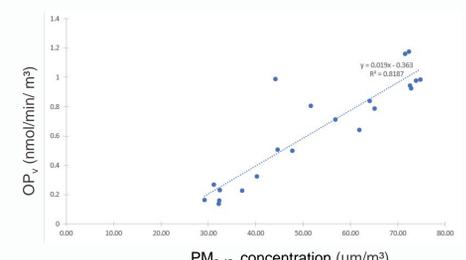


Figure 3: R-squared (R²) correlation between PM_{0.49} concentration and OP_v

CONCLUSION

This study highlights the variations in oxidative potential (OP) of PM_{0.49} during smoke haze and non-smoke haze periods. The significant increase in PM_{0.49} concentration OP_v and OP_m during the smoke haze period suggests a higher level of oxidative stress and increase potential health risk. And the future studies should further evaluate PM sources and chemical composition contributing to OP variations to better understand their impact on health.

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