TOXICOLOGICAL EFFECTS OF PARTICULATE MATTER FROM RESIDENTIAL COAL COMBUSTION

D. Figueiredo[1,2], E.D. Vicente[2], A.I. Calvo[3], R. Fraile[3], H. Oliveira[1], C. Alves[2]

[1]Department of Biology, Centre for Environmental and Marine Studies (CESAM), University of Aveiro, 3810-193 Aveiro, Portugal
[2]Department of Environment and Planning, CESAM, University of Aveiro, 3810-193 Aveiro, Portugal
[3]Department of Physics, University of León, León, 24071, Spain

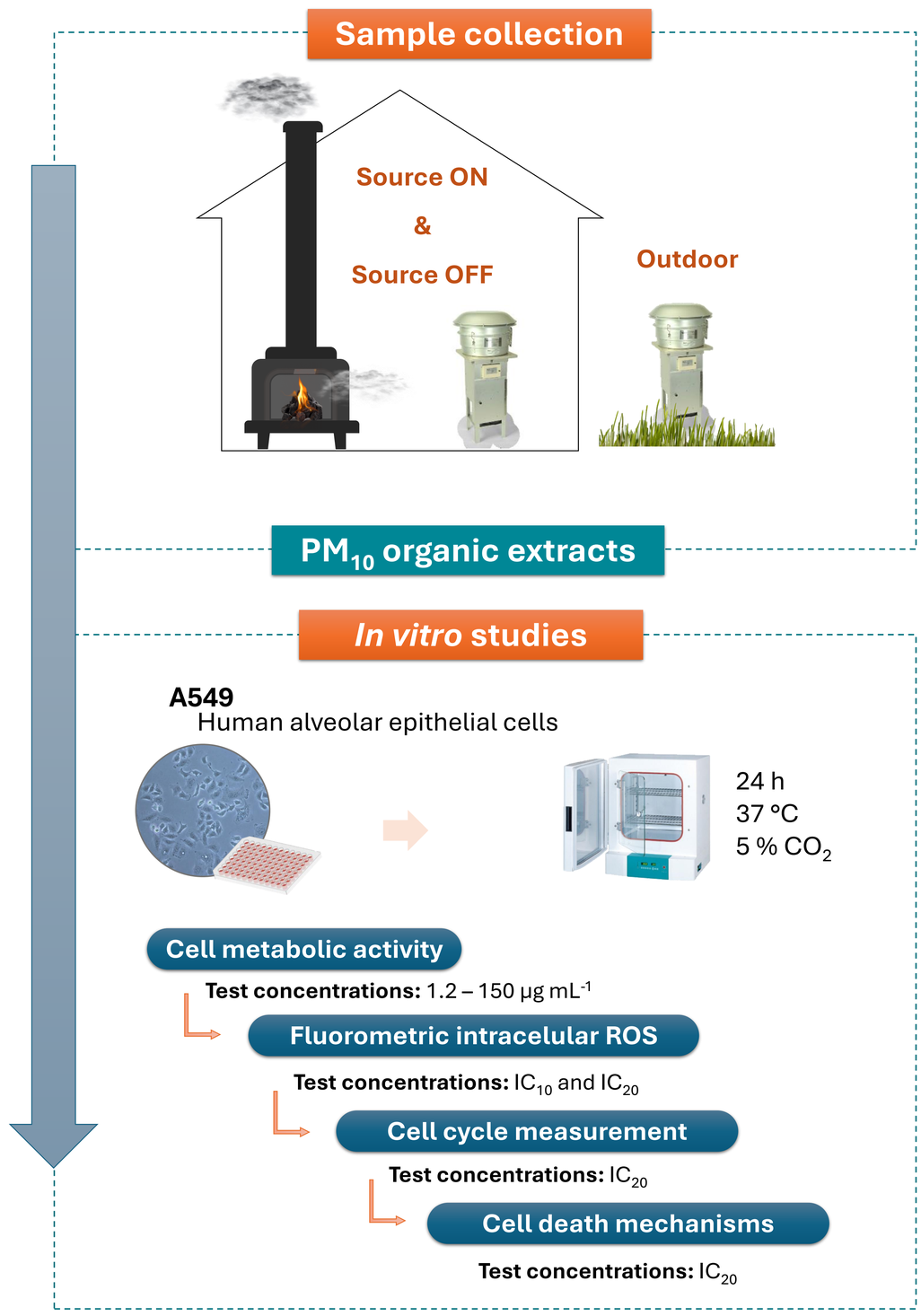
1 INTRODUCTION

Residential coal combustion is a significant source of airborne particulate matter (PM) pollution (Zhou et al., 2020). Coal remains a widely used household heating source driven not only by economic and availability considerations but also by cultural practices (Kerimray et al., 2017). PM emissions from coal combustion have been linked to cytotoxicity, oxidative stress, genotoxicity, and inflammation in different cell lines (Huang et al., 2023; Ihantola et al., 2022).

AIM

This study aimed to evaluate the toxicity of indoor PM samples lower than 10 µm (PM_{10}) from residential coal combustion in a European household using coal for heating purposes in human alveolar epithelial cells (A549).

2 METHODS



3 RESULTS

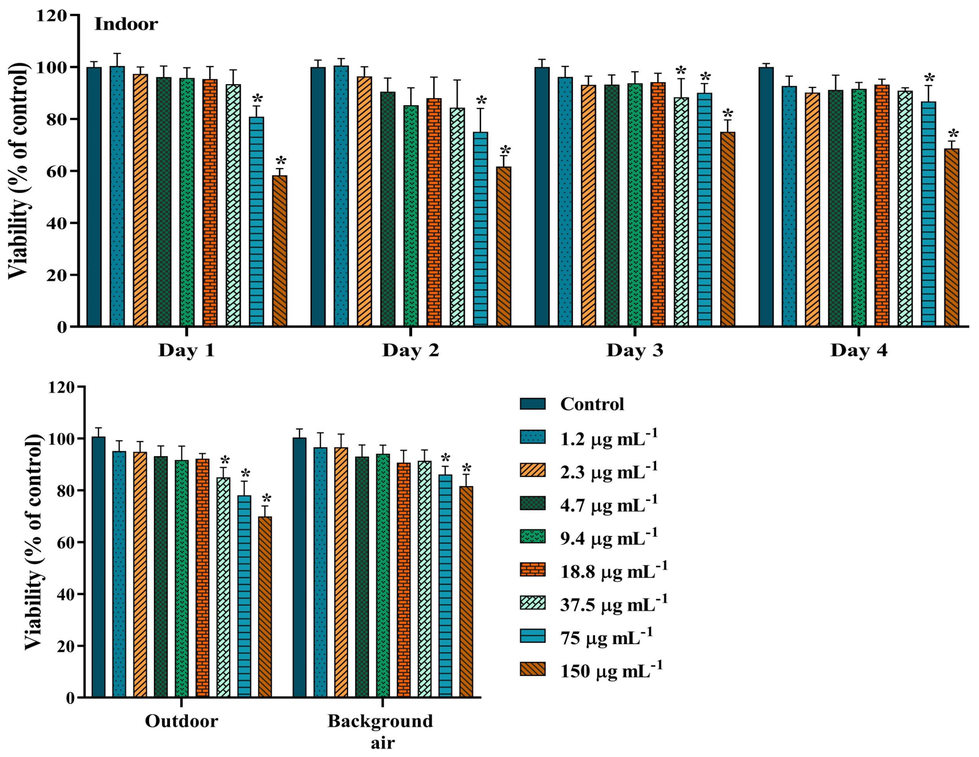


Figure 1. Cell viability of A549 cells assessed with the MTT assay after 24 h exposure of increasing concentrations of PM_{10} from residential coal combustion. Bars represent mean ± standard deviation. Asterisks indicate statistical significance relative to the control group ($p < 0.05$).

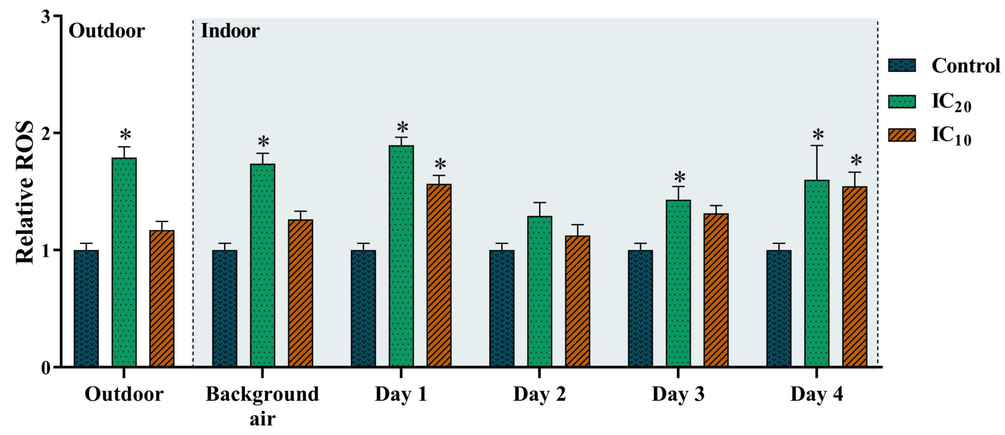


Figure 2. Intracellular ROS production after 24 h exposure of A549 cells to PM_{10} from residential coal combustion at the concentration of the IC_{10} and IC_{20} using the fluorometric intracellular ROS kit. Bars represent mean ± standard deviation. Asterisks indicate statistical significance relative to the control group ($p < 0.05$).

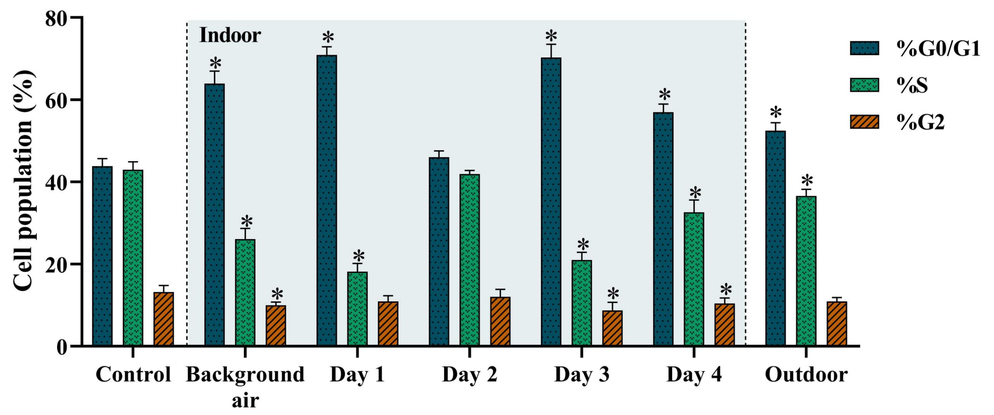


Figure 3. Effects of PM_{10} from residential coal combustion at the concentration of the IC_{20} after 24 h exposure on A549 cell cycle distribution. Bars represent mean ± standard deviation. Asterisks indicate statistical significance relative to the control group ($p < 0.05$).

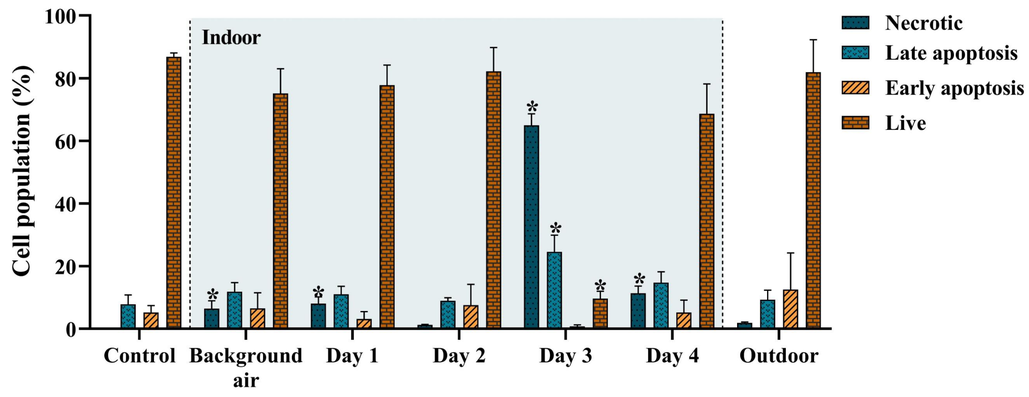


Figure 4. Effects of PM_{10} from residential coal combustion on cell death apoptosis in A549 cells after 24 h exposure at the concentration of the IC_{20}. Bars represent mean ± standard deviation. Asterisks indicate statistical significance relative to the control group ($p < 0.05$).

4 CONCLUSIONS

- PM_{10} organic extracts significantly reduced the metabolic activity of A549 cells and triggered oxidative stress.
- A significant increase in the G1 phase and a decrease in the S phase were observed, indicating cell cycle arrest.
- An increase in necrotic cell populations was observed, suggesting persistent DNA damage or failure in DNA repair, which impedes replication and transcription, ultimately leading to cell death.

REFERENCES:

Huang W., Luo X., et al. (2023). Fuel, 353, 129207.

Kerimray A., Rojas-solórzano L., et al. (2017). EnergySustain. Dev. 40, 19–30.

Zhou Y., Zi T., Lang J., et al. (2020). Chemosphere, 260, 127517.

ACKNOWLEGMENTS:

This work was done within the projects i) APAM, supported by national funds (OE), through FCT/MCTES (DOI: 10.54499/2022.04240.PTDC) and ii) TED2021-132292B-I00, supported by "NextGenerationEU"/PRTR and MCIN/AEI/10.13039/ 501100011033. The financial support to CESAM by FCT/MCTES (UIDP/50017/2020 + UIDB/50017/2020 + LA/P/0094/2020), through national funds, is acknowledged. D. Figueiredo thanks the grant 2020.06414.BD from FCT, which is also acknowledged for the research contracts under Scientific Employment Stimulus to H. Oliveira (DOI 10.54499/CEECIND/04050/2017/CP1459/CT0023) and E. Vicente (DOI: 10.54499/2022.00399.CEECIND/CP1720/CT0012).