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ONEČIŠĆENJE ZRAKA GORENJEM BIOMASE U KONTINENTALNOM DIJELU HRVATSKE

BIOMASS BURNING AIR POLLUTION IN CONTINENTAL CROATIA

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INTRODUCTION

Most air pollution studies in Croatia indicate that, besides traffic, household heating including biomass burning is a major contributor to overall air pollution. Due to incomplete combustion, biomass type, and burning regime, a variety of pollutants such as particulate matter, some gases, organic and inorganic compounds, and metals are emitted into the atmosphere. However, because these species often share mutual sources, the biomass burning contribution to air pollution is typically determined using statistical techniques or modelling. Recently, levoglucosan has been confirmed and accepted as unique tracer since it is formed exclusively during cellulose and hemicellulose pyrolysis.

This research focuses on determining airborne praticulate matter smaller than 2.5 µm ($PM_{2.5}$) and levoglucosan (LG) levels to study the biomass-burning contribution to air polution at a suburban background station in continental area, where wood is widely used for residential heating, agricultural activities are prevalent. Seasonal variations of LG were determined and compared with the levels at urban background site. The influence of wind direction to LG levels and seasonality of LG contribution to $PM_{2.5}$ fraction were observed.

RESULTS

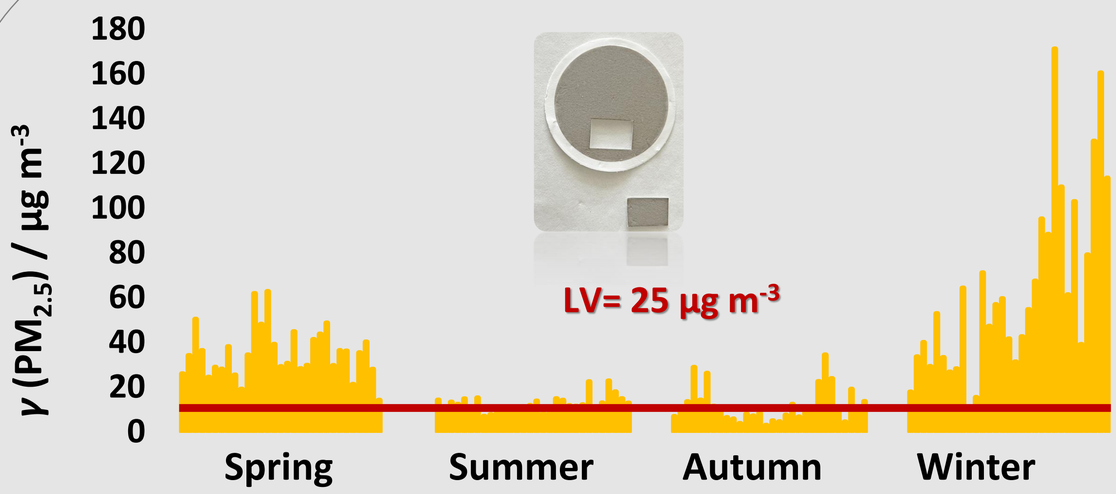

Fig 1. Mass concentration of $PM_{2.5}$ collected at suburban background station in continental area

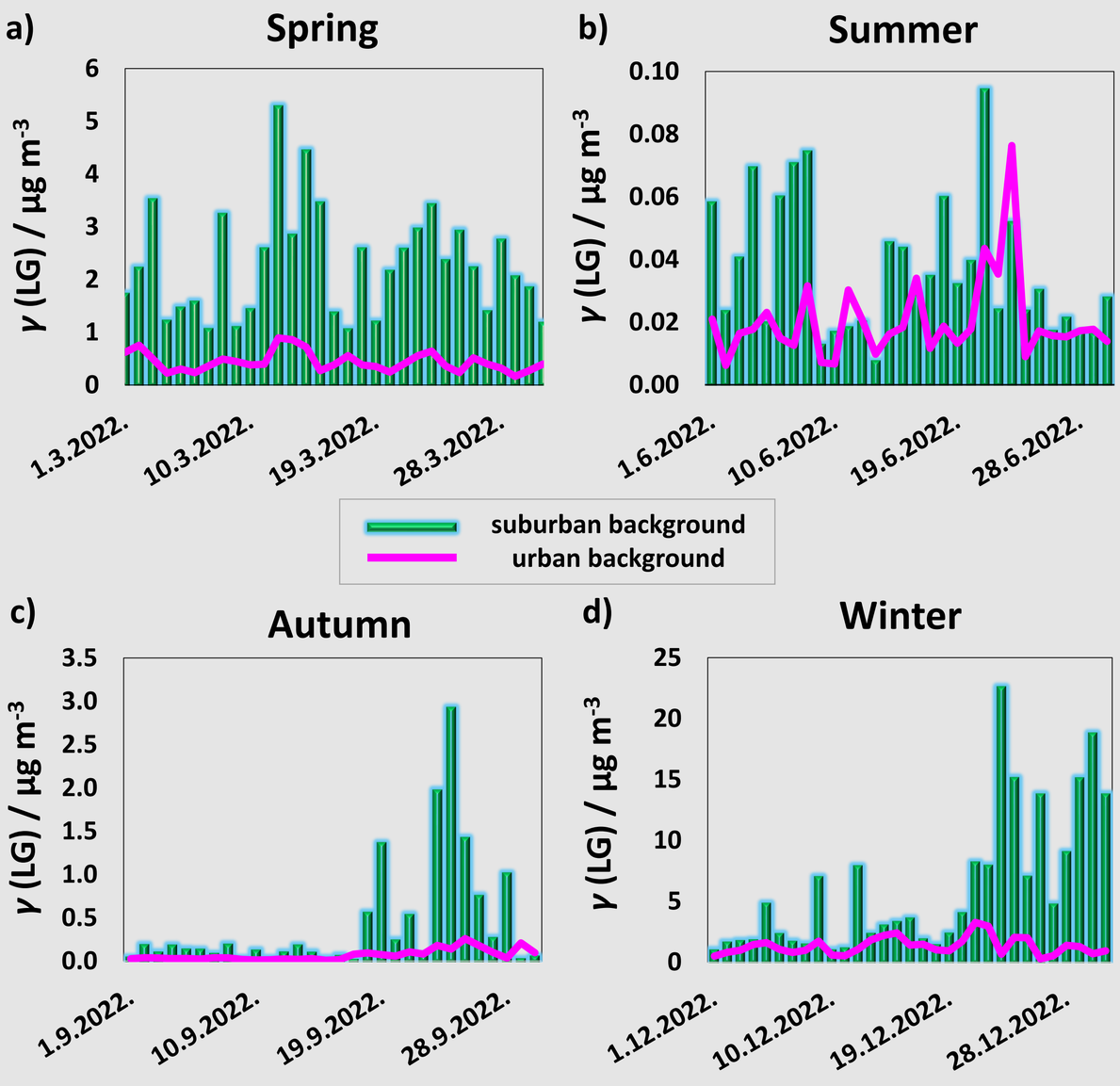

Fig 2. Comparison of levoglucosan mass concentration in $PM_{2.5}$ measured at suburban and urban background site during a) spring, b) summer, c) autumn and d) winter season

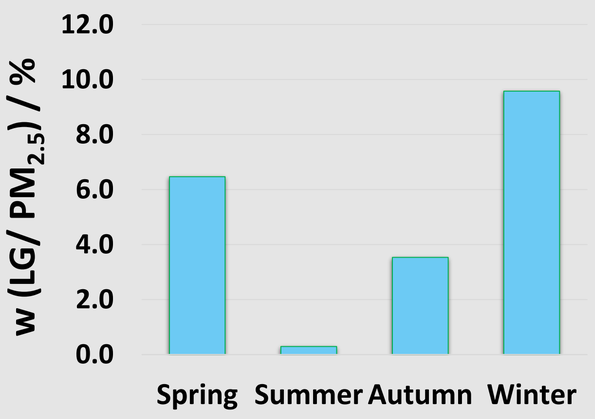

Fig 3. Average abundance of LG in $PM_{2.5}$ fraction in different seasons

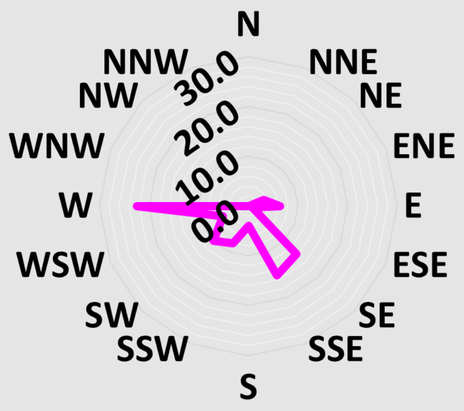

Fig 4. LG concentration (µg m^{-3}) depandance on wind direction during winter

EXPERIMENTAL

Sampling of $PM_{2.5}$ fraction

LVS3 Sven Leckel Sampler
Air flow: 55 m^3/day

24-hour samples
30 days per season in 2022

Whatman® QM-A quartz filter (***A*** = 13.85 cm^2)

Sample preparation

Ultrasonic extraction and centrifugation of samples
in ultrapure water (κ = 0.055 µS cm^{-1})

Sample analysis

ICS-6000 Thermo Fischer Scientific, HPAEC-PAD

Eluent: NaOH, 0.4 ml/min
Separation column: CarboPac™ MA1, Thermo Fischer Scientific

CONCLUSIONS

✓ The seasonal trend of $PM_{2.5}$ levels showed a decreasing pattern in the following order: winter > spring > summer > autumn. The average levels were 63.6, 35.3, 12.5, and 11.9 µg m^{-3} during the winter, spring, summer, and autumn seasons, respectively. The maximum daily mass concentration of $PM_{2.5}$ observed during winter was 171 µg m^{-3} (Fig 1).

✓ Comparing the overall daily average $PM_{2.5}$ levels to the annual limit value of 25 µg m^{-3} set by the EU Ambient Air Quality Directive 2008/50/EC, it is evident that the levels exceeded the limit during two seasons: winter and spring.

✓ The average levoglucosan levels were 0.036, 0.419, 2.281 and 6.094 µg m^{-3} in summer, autumn, spring and winter season. Maximum daily mass concentrations of levoglucosan of 22.478 µg m^{-3} was registered during winter (Fig 2).

✓ The highest levels of levoglucosan during winter indicate the frequent use of biomass for residential heating, which is the most common fuel in the continental part of Croatia. Conversely, the elevated levels in spring could be attributed to the burning of agricultural waste.

✓ Comparing the levoglucosan levels at suburban and urban background sites revealed the same seasonal trend, though the average values were two to six times higher depending on the season.

✓ Depanding of the season, avarage abundance of LG in $PM_{2.5}$ fraction is between 0.3 – 9.6% (Fig 3).

✓ The LG concentration dependence on the wind direction revealed that during winter higher LG levels were registered when the wind blew from the west, southeast or south-southeast (Fig 4).

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