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# Magnetic Response of Airborne Metal Contaminants Captured by Spider Webs

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A b s t r a c t

Airborne particulate matter (PM) that originates from the combustion of fossil fuels is of concern due to adverse effects on the environment and human health (Rogula-Kozłowska 2015). Classic monitoring methods based on PM collectors and subsequent chemical analyses are expensive and time consuming. As a result, time- and cost-effective methods were in demand. Results from several studies have identified spider webs as an excellent source of biomonitors (Flanders 1994, Rybak 2015). Spider webs accumulate pollutants to which humans are exposed; thus, they are a reliable source of information about the quality of the environment in a way that is similar to other bioindicators. Compared to conventional atmospheric pollution monitoring, the assessment of air quality with the use of spider webs is cheap, non-invasive and easy as webs are abundant and they are woven in secluded locations, which prevents them from exposure to rain and wind. The basis of the present study was an assumption that because spider webs are diamagnetic (with negative magnetic susceptibility), the increased value of their magnetic susceptibility that results from exposure to the polluted atmosphere may be a sign of contamination by particulates (of which some are metallic). Therefore, the proposed hypothesis is that magnetic susceptibility of spider webs reflects the level of ambient air pollution.

The study involved the investigation of indoor and outdoor webs made by six types of spiders. Additionally, street dust was the subject of study. Volumetric magnetic susceptibility ($\kappa$) of dried and weighted samples was measured using an MFK1 Kappabridge device (Agico Advanced Geoscience Instruments Co., Brno) and afterwards, recalculated into mass-specific magnetic susceptibility ($\chi$).

The $\chi$ values varied from $-1.7 \times 10^{-8}$ $m^3 kg^{-1}$ (obtained for samples of clean spider webs treated as reference diamagnetic samples) to above $400 \times 10^{-8}$ $m^3$ $kg^{-1}$ obtained for samples collected in very busy district of Grunwaldzki Square in Wrocław, which is a large,

congested traffic circle with bus stops and tramways. Similarly, the $\chi$ of street dust collected from the same location was the highest as well. When comparing the outdoor and indoor data, outdoor samples of spider webs exhibited higher values of magnetic susceptibility. Therefore, the magnetic susceptibility of webs was directly related to the presumption that webs—with the exception of fine particles that originate from anthropogenic emission—are able to trap particles greater than 10 μm, which are characteristic of road or street dust and soil dust (or a mixture of both), and they generally do not occur in an indoor atmosphere (Rogula-Kozłowska 2015). Moreover, the magnetic susceptibility values differed depending on the species of the spider as well as on the exposure period. Results obtained for the outdoor samples seem to be influenced mainly by the road traffic and industrial emissions, while the results observed from the indoor samples seem to be related to some internal sources of PM, such as combustion of various fuels in domestic furnaces, dust from vacuum cleaners, printers, cooking and smoking (Rachwał *et al*. 2018).

The results support the statement that magnetic biomonitoring with spider webs is an useful approach to delineate airborne PM pollution that originates from sources such as traffic emissions, industrial activity, and emissions from domestic heating systems. Such a tool is needed because we currently rely mainly on time-consuming analyses when assessing air quality. With the use of magnetic biomonitoring, we are able to generate quick and reliable information about the quality of the air both outdoors and indoors.

**Keywords:** spider webs, magnetic susceptibility, airborne particulate matter, indoor air, outdoor air.

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