Abstract

Environmental contamination by heavy metals constitutes a major challenge in environmental toxicology, as well as in public and veterinary health. Elements such as arsenic, cadmium, lead, mercury, nickel, and chromium are characterized by high persistence and a strong tendency to bioaccumulate. Their presence in the environment results from both natural processes and, predominantly, anthropogenic activities, including industrialization, transport, fossil fuel combustion, and intensive agriculture. Consequently, these elements accumulate in soil, water, and air, entering the bodies of humans and animals.

Heavy metals exert multidirectional toxic effects, affecting the nervous, endocrine, immune, and reproductive systems, as well as vital organs such as the liver and kidneys. Many also demonstrate carcinogenic and genotoxic properties. Due to their cumulative nature, even low-level, long-term exposure may result in significant adverse health effects.

Dogs constitute a valuable model in biomonitoring studies, as they share the human environment and are exposed to similar contaminants. Their physiological responses may therefore serve as indicators of environmental pollution and support environmental risk assessment.

Canine hair is increasingly applied as a biological matrix, as it enables the evaluation of long-term exposure, in contrast to blood or urine, which reflect short-term fluctuations. Its advantages include non-invasive sampling, ease of collection, and the possibility of storage without specialized conditions.

The aim of this study was to assess the exposure of dogs from the Iława and Nowe Miasto counties (Warmian-Masurian Voivodeship) to selected heavy metals (As, Cd, Cr, Ni, Pb, Hg) based on their concentrations in hair, and to evaluate the influence of selected biological and environmental factors.

The study included 100 dogs of various breeds, sexes, and ages (0.5–17.5 years), originating from both urban and rural environments. Hair samples were collected from the abdominal region. The material was subjected to microwave-assisted digestion and analyzed using ICP-OES.

All analyzed metals were detected, confirming environmental exposure. Mean concentrations were: As—0.037 µg/g, Cr—0.412 µg/g, Cd—0.017 µg/g, Ni—0.564 µg/g, Pb—0.508 µg/g, and Hg—0.100 µg/g. The greatest variability was observed for nickel, whereas arsenic showed the lowest variation.

The results indicate that even in areas with relatively low levels of industrialization, animals remain exposed to heavy metals, likely due to diffuse sources such as traffic emissions, domestic heating, agricultural practices, and contaminated feed and water.

Hair proved to be a valuable matrix for assessing long-term exposure, despite limitations related to potential external contamination. The findings expand current knowledge on heavy metal exposure in dogs in Poland and confirm the applicability of hair analysis in environmental monitoring and veterinary practice.