Chapter 21
Heavy Metal Levels in Dog Liver and Kidney in Naples (Campania, Italy)

F. P. Serpe, R. Russo, R. De Luna, S. Florio, M. Esposito and L. Severino

Abstract The aim of the current study was to carry out a retrospective analysis of heavy metal (Pb, Cd, and Hg) levels in liver and kidney of 38 dogs living in an urban habitat (city of Naples). Tissues were homogenized, digested in a microwave digestion system, and analyzed by atomic absorption spectrometry. The results of this study showed generally low levels of heavy metals in tissues of all examined dogs; only mercury concentrations in kidneys of pet dogs were higher than in stray dogs, and no significant age-dependent differences in metal levels were shown between the two groups. In conclusion, these results suggest the involvement of *ad hoc*-formulated pet food exposure to heavy metals in domestic animals.

Keywords Dog · Heavy metals · Environment

21.1 Introduction

Environmental contamination by heavy metals is almost ubiquitous. Their presence is partly attributable to the natural abundance of heavy metals in the earth's crust in addition to human activities. Some of these metals, besides not being essential for living organisms, are significantly toxic. Given the paucity of the scientific literature on the exposure of domestic species to heavy metals (Sakai et al. 1995; Balagangatharathilagar et al. 2006; Lopez-Alonso et al. 2007), the purpose of this study was to undertake a retrospective analysis of the levels of lead,

F. P. Serpe (✉) · M. Esposito
Istituto Zooprofilattico Sperimentale del Mezzogiorno, Dipartimento di Chimica, Portici, NA, Italy
e-mail: francesco.serpe@izsmportici.it

R. Russo · R. De Luna · S. Florio · L. Severino
Università degli Studi di Napoli Federico II, Facoltà di Medicina Veterinaria, Naples, Italy

C. Boiti et al. (eds.), *Trends in Veterinary Sciences*,
DOI: 10.1007/978-3-642-36488-4_21,

cadmium, and mercury in tissues of dogs (stray and domestic) that died from various causes, all living in the urban area of Naples.

21.2 Materials and Methods

As part of the necropsy of the 38 dogs from the Department of Pathology and Animal Health, University of Naples "Federico II," livers and kidneys were collected and stored at −20 °C until analysis. Aliquots of homogenized bodies were taken, after thawing, equal to 0.50 ± 0.01 g; wet mineralization of the samples was performed by treating each aliquot with 4.0 mL of 70 % HNO_3 (Carlo Erba) and 1.5 mL of 30 % H_2O_2 (Baker Analyzed) in a total volume of 8.0 mL (difference made with deionized water) for atomic absorption spectroscopy (Best Chemicals) in a microwave oven (Milestone, FKW) at a temperature of 190 °C. The sample was analyzed for lead and cadmium levels using an atomization technique in a graphite furnace (AAS 800, Perkin Elmer) and for total mercury levels using the hydride generation technique (AAS 3110, Perkin Elmer). Quantification was carried out after external standardization, correcting for recovery percentage. The animals, divided into domestic (n = 19) and stray (n = 19) groups, were further divided into groups according to age (Group I: 2–9 years, Group II: 10–17 years). The results obtained were statistically processed using the Student's *t* test.

21.3 Results

The results of this work are summarized in Table 21.1. With regard to lead, which was present in all examined samples, levels between 0.074 and 0.949 mg/kg ($X_m = 0.321$) in the liver and between 0.049 and 1.001 ppm in the kidney

Table 21.1 Levels of lead, cadmium, and mercury in liver and kidney (mg/kg f.w.) of dogs from the urban area of Naples (n = 38)

	Pb	Cd	Hg
Liver			
Average	0.321	0.093	0.054
SD	0.198	0.079	0.044
Min	0.074	ND	ND
Max	0.949	0.352	0.418
Kidney			
Average	0.293	0.259	0.040
SD	0.231	0.238	0.021
Min	0.049	0.011	ND
Max	1.001	0.984	0.328

($X_m = 0.293$) were detected. For cadmium, found in all kidney samples and 95 % of all liver samples, the concentrations ranged from ND to 0.352 mg/kg ($X_m = 0.093$) in the liver and between 0.011 and 0.984 mg/kg ($X_m = 0.259$) in the kidney. Finally, for mercury, present in 83 % of all samples, values between ND and 0.418 mg/kg ($X_m = 0.054$) were found in liver samples, whereas in the kidney, the levels of this metal ranged between ND and 0.328 mg/kg ($X_m = 0.040$). The higher concentrations of mercury were found in domestic subjects.

21.4 Discussion

The results of this study showed that all subjects examined have been exposure to at least one heavy metal, although hepatic and renal concentrations of all metals were not generally considered likely to give rise to clinical toxicity (Hansmann et al. 2009). In particular, with regard to lead, measured concentrations were higher than the other metals but lower than values considered "normal" in the kidney of the canine species (Beretta 1984). For cadmium, the highest levels were found in the kidney ($X_m = 0.25$ mg/kg), which represent, as well-known, the organ in which this metal has a particular tropism. Even mercury concentrations detected provide signs of a generally low exposure to this metal, but its concentrations in the kidney were higher in domestic than in stray dogs ($P < 0.01$). With regard to age, no statistically significant differences were detected between the two groups.

Despite the limited number of subjects and the different variables inherent in such a retrospective study, the results of this work, which we consider preliminary, provide guidance to continue a wider study of different nutritional statuses and living environments. In particular, the major concentrations of mercury found in domestic dogs might be considered as a starting point to investigate the role of diet in exposure of pets to contaminants that may end in inadequately controlled commercial food.

References

Balagangatharathilagar M, Swarup D, Patra RC, Dwivedi SK (2006) Blood lead level in dogs from urban and rural areas of India and its relation to animal and environmental variables. Sci Tot Environ 359:130–134

Beretta C (1984) Piombo. In: Beretta C (ed) Tossicologia Veterinaria. Editoriale Grasso, Bologna, pp 153–166

Hansmann F, Stephan I, Wirtz A, Gruber AD, Wohlsein P (2009) Mercury poisoning in a German shepherd dog. Vet Rec 165:447–448

Lopez-Alonso M, Miranda M, García-Partida P, Cantero F, Hernández J, Benedito JL (2007) Use of dogs as indicators of metal exposure in rural and urban habitats in NW Spain. Sci Tot Environ 372:668–675

Sakai T, Ito M, Aoki H, Aimi K, Nitaya R (1995) Hair mercury concentrations in cats and dogs in central Japan. Br Vet J 151:215