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Lead Poisoning Mortality in Wild Passeriformes and its Detection in Free-Range Chicken Eggs in Southern Minas Gerais, Brazil

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ABSTRACT

The mortality of passerines native of Southern Minas Gerais, Brazil, in August 2006 and the examination of sentinel free-range chicken eggs in August 2007 in an area surrounding a car battery lead smelter plant is described. The high levels of lead, as detected in the passerines (4.80-12.74 mg/kg) at the onset of mortality and at the follow-up sampling of the free-range chicken eggs (25.02-35.21 mg/kg in shells, 0.41-1.36 mg/kg in yolks and 0.40-0.75 mg/kg in the albumins), used as environmental sentinels, indicated the continuing lead pollution.

INTRODUCTION

Lead is a highly toxic and the main heavy metal causing intoxication of birds. The most common sources of lead are fishing weights, important for aquatic birds as lead shots, and for caged birds, lead-containing paint (Brown & Julian, 2003). Avian poisoning may be sub-lethal or lethal and affect birds and other animals living near sources of lead (Pain *et al*., 1995). The recycling of lead from car batteries has become an important issue as far as environmental pollution is concerned. The recycling of car batteries is essential for proper disposal of such lead-containing material. However, lead processing requires adequate chemical safety procedures to prevent the exposure of humans and the environment (Levine *et al*., 1976). This paper reports an episode of acute lead poisoning causing mortality in passerines of the Brazilian fauna in August 2006, and describes a follow-up investigation in August 2007 in the same area, on the contamination of free-range chickens producing subsistence consumable eggs, in an area surrounding a lead smelting plant of Southern Minas Gerais, Brazil, aiming to alert for the environmental, animal and human risk.

MATERIALS AND METHODS

Passeriformes of the species "Blue Dacnis" (*Dacnis c. cayana*), one male and 2 females; "Chestnut-vented Conebill" (*Conirostrum s. speciosum*), one female; "Rufous-browed Peppershrike" (*Cyclarhis gujanensis*), one male; and "Sayaca Tanager" (*Thraupis sayaca*), 2 males, were found dead in an area surrounding a lead recycling plant and sent by the Police Department to the Avian Diseases Laboratory at the Veterinary College (Universidade Federal de Minas Gerais, Brazil) for diagnosis in August 2006. Eggs (n=33) of eleven flocks of free-range chickens of the neighboring area were sampled at 11 sites as environmental sentinels one year later (August 2007). The smelter plant is pointed by the white arrow below site 3 on the map (Figure 1). Lead atomic absorption spectrophotometer analyses were performed in liver, lung, heart and intestinal sampled of passerines pooled by location, in

free-range chicken egg shells (n=11), yolks (n=11) or albumen (n=11) (Lab. Hidrocepe, Belo Horizonte, Brazil).

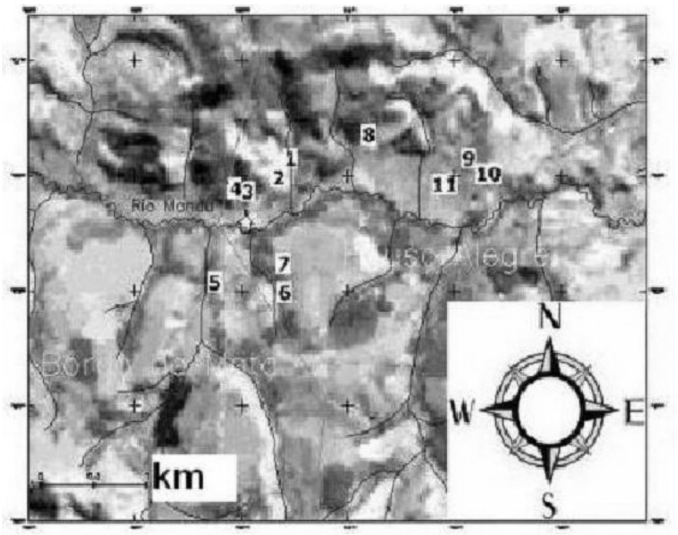

Figure 1 - Free-range egg sampling area.
The geographical location of the eleven collection sites are shown. The smelter plant is located as indicated by the arrow positioned below site number 3. The geographical coordinates and values in shell, yolk and albumin, respectively, in mg/kg, at each location are as follows
site 1: S22°16'23.3" W46°03'26,4"/843m, 29.55, 1.36 and 0.48;
site 2: S22°16'28.9" W46°03'30,4"/870m, 27.12, 1.34 and 0.49;
site 3: S22°16'32.8" W46°03'40,4"/852m, 30.58, 1.25 and 0.66;
site 4: S22°16'31.9" W46°03'44,6"/842m, 25.02, 0.97 and 0.62;
site 5: S22°16'58.2" W46°03'51,4"/844m, 28.40, 0.90 and 0.49;
site 6: S22°17'01.5" W46°03'28,7"/848m, 28.12, 0.41 and 0.42;
site 7: S22°16'53,2" W46°03'29,3"/847m, 35.21, 0.72 and 0.67;
site 8: S22°16'17,1" W46°03'00,9"/838m, 33.07, 0.82 and 0.40;
site 9: S22°16'23,9" W46°02'28,2"/843m, 27.69, 0.81 and 0.67;
site 10: S22°16'28.3" W46°02'21,6"/862m, 29.73, 0.97 and 0.64;
site 11: S22°16'31.4" W46°02'36,0"/862m, 34.14, 1.03 and 0.75.
Note: Values for each location are latitude South, longitude West, altitude, and lead concentrations (mg/kg) found in the shell, yolk and albumen, respectively, of free-range chicken eggs.

RESULTS AND DISCUSSION

In the laboratory, passerine species were identified (Figure 2) and the acute or superacute aspect of the disease of the otherwise apparently healthy birds was noted during necropsy. Whitish material deposits (Figure 3) were observed in the oral cavity obstructing the palatine cleft, which was swollen, indicating the ingestion or action of an irritating substance on the palate, in the intestinal lumen, as well as on the liver surface (Figure 3), and in the liver parenchyma. The whitish deposits were also visible in the lungs, indicating inhalation, in the kidneys parenchyma, possibly as a result of circulating levels in blood, and also accumulated in the thoraco-abdominal cavity (Figure

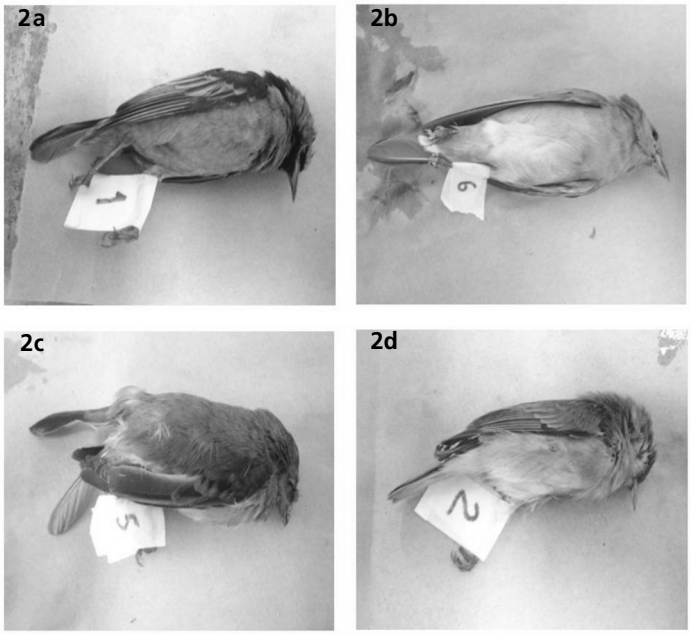

Figure 2 - Passerine species examined.
The Passeriformes of species "Blue Dacnis" (Fig. 2a, *Dacnis c. cayana*), one male and 2 females, "Sayaca Tanager" (Fig. 2b, *Thraupis sayaca*), 2 males, "Chestnut-vented Conebill" (Fig. 2c, *Conirostrum s. speciosum*), one female and "Rufous-browed Peppershrike" (Fig. 2d, *Cyclarhis gujanensis*), one male, were found dead in an area surrounding a lead recycling plant.

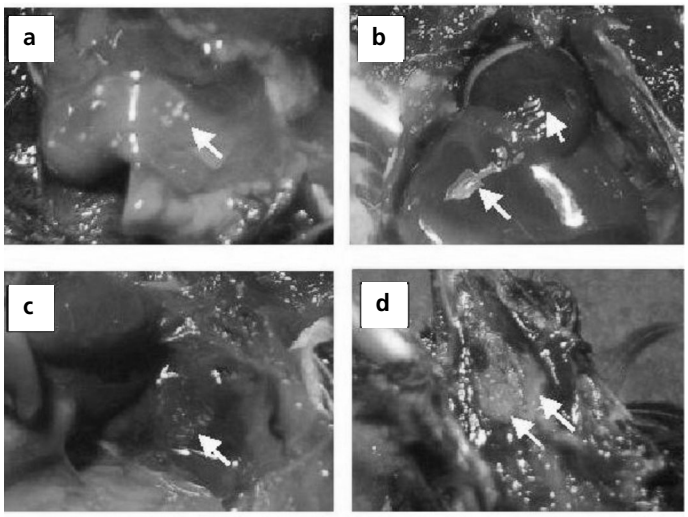

Figure 3 - Typical lesions observed at the necropsy of passerines.
a. *Dacnis c cayana*. Intestinal insoluble whitish material (arrow). b. *Thraupis sayaca*. Insoluble whitish material deposit on the liver surface (long arrow). Note cardiac distension. (short arrow, darker area). c. *Cyclarhis gujanensis*. Pulmonary whitish deposits (arrow). d. *Cyclarhis gujanensis*. palatine cleft mucosal lesion (arrows).

3). The concentrations of lead in the passerines ranged between 4.80 and 12.74mg/kg (4.80-12.77mg/kg) in the pooled visceral and tubular organs samples of each individual (Table 1). Free-range chickens eggs

Table 1 - Lead concentrations in passerine species and post mortem examination details.

Scientific name	Lead levels (mg/kg)	Lesions at necropsy
Conirostrum s. speciosum	7.38	Whitish deposits ~1mm∅ on the surface of the enlarged liver; swollen cloaca
Cyclarhis gujanensis	7.48	Palatine cleft swollen and obstructed; whitish deposits (~1mm∅) in the lungs
Dacnis c. cayana	7.98	Whitish deposits on the skin (<2mm∅)
Dacnis c. cayana	4.80	Whitish deposits in the intestinal lumen (<2mm∅)
Dacnis c. cayana	6.79	Whitish round (approx. 1mm∅) deposits on the liver surface
Thraupis sayaca	11.55	Intraperitoneal fine granular deposits (~1mm∅); cardiac distension
Thraupis sayaca	12.74	Intraperitoneal fine granular deposits (<2mm∅); cardiac distension

presented average levels of 29.87mg/kg (sd 3.14) in the eggshell, varying from 25.02 to 35.21mg/kg; 0.97mg/kg (sd 0.26) in the yolk, ranging from 0.41 to 1.36mg/kg; and 0.57mg/kg (sd 0.11) in the albumen, varying from 0.40 to 0.75mg/kg (Figure 1). These values are considered higher than the environmental reference levels previously detected in Rio de Janeiro, Brazil, of 1,5mg.m^3 of air (Quiterio *et al*., 2006). The main mode of lead contamination is possibly through the inhalation of fumes produced by lead smelting. The studied wild passerines species feed on fruits, nectar, and insects in the tree-crown environment (Manhães, 2003), which may be more protected from lead intoxication than ground-foraging species, unless the source of lead is present in the air as a vapor, as it might have happened in the neighborhood of the smelter. On the other hand, the fruits of the foraging trees might have also accumulated lead. In this episode, the distance may not be have had a role in the observed intoxication, in contrast with Levine *et al*. (1976), who detected geese mortality and clinical signs in cows at 300m but not at 700-900m from the smelter.

Lead contamination is a growing environmental concern (Projeto Geomed, 2008; Quiterio *et al*., 2006, Sanderson & Bellrose, 1986). The dietary concentrations of lead acetate for fatal toxicity in chickens can be very high, from 320 (Damron *et al*., 1969) up to 1,000mg/kg (Vengris & Mare, 1974), allowing high levels of lead to be transferred to the chicken carcass and egg. Trampel *et al*. (2003) found levels of 0.02-0.40mg/kg in the egg yolk and 0.45mg/kg in the eggshell of surviving lead-paint intoxicated chickens. On the other hand, our results were more than 66 times higher in chicken eggshells than those found by those authors, and more than 2.4 times the maximum value found in yolks.

The relevance of such findings may be considerable due to the possibility of high levels of lead being transferred to humans through chicken products. Lead intoxicated free-range chickens may maintain their egg production stable, as the chicken species is highly resistant to lead poisoning (Damron *et al*., 1969). For this reason, free-range chickens may function as long-term environmental sentinels, accumulating high levels of lead before developing clinical signs. The presence of mainly airborne lead in the area of study as fumes from smelting may also result in direct human contamination, as revealed by tests with workers and resident neighbors (unavailable data from the Municipal Department of Public Health).

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