Short Communication

LEAD FRAGMENTS IN TISSUES FROM WILD BIRDS: A CAUSE OF MISLEADING ANALYTICAL RESULTS

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ABSTRACT

Seriously damaged eider ducks (Somateria mollissima) and long-tailed ducks (Clangula hyemalis) were shot in connection with an oil spill in 1974. Liver and kidney tissues were analyzed for environmental pollutants and lead analysis gave irreproducible results. By means of X-ray photographs, X-ray-dense particles could be observed in the tissues.

The foreign particles were extracted by dissolution of the organ tissues in Soluene-350 (Packard Instruments Co. Inc) and then washed with toluene. The insoluble particles consisted of lead and bone splinters of varying size. The form of the former ranged from irregular fragments to dust, and arose by disruption of lead pellets upon collision with bone tissue.

Birds shot with lead pellets should not be used for lead determination unless careful X-ray investigations are made prior to the chemical analysis. Determinations should be made on at least two different samples of the tissue examined.

INTRODUCTION

Systematic investigations are carried out at the Swedish National Veterinary Institute to establish the causes of death of wild animals. The mortality can be caused by inanition, infectious and non-infectious diseases of different kinds and intoxications. Other causes may be traumatic injuries, including wounds, as well as animals in bad condition and purposely killed, or animals shot in connection with sampling for comprehensive studies.

In addition to the post-mortem examination, chemical analysis for essential and non-essential elements is carried out on organ tissues of the animals sent to the Institute. For a few animals, especially birds, a large discrepancy was obtained between lead determinations of different samples of the same tissue. As contamination was suspected, the intention of this work was to find the cause of the discrepancy.
MATERIALS AND METHODS

Animals

In connection with an oil spill in 1974, damaged long-tailed ducks (Clangula hyemalis) and common eider (Somateria mollissima) were shot, within the scope of an investigation of environmental pollutants. Organ tissues (liver and kidneys) were collected at autopsy and kept at −20°C until analysed.

Chemical analysis

Organ tissues were pretreated by automatic wet digestion (see Frank, 1976) using a mixture of concentrated nitric and perchloric acids. The residue was then dissolved in water. Lead analysis was undertaken at 283.3 nm by atomic-absorption spectrometry (Perkin-Elmer model 303) after extraction with APDC (1-pyrrolidinedithiocarboxylic acid ammonium salt) in MIB-ketone (methyl isobutyl ketone) as described by Frank and Borg (1979).

X-ray photographs

The tissues were placed in polystyrene Petri dishes and X-rayed by placing them above a sheet of film enclosed in an X-ray cassette. The organs appeared as grey shadows against a black background. White dots and irregular white to pale spots identified contaminating particles.

Dissolution of tissue samples

Those parts of tissues in which X-ray-dense particles were found were separated, solubilized and the insoluble particles isolated. One part of organ tissue was treated with 10 parts of Soluene-350 (Packard Instruments Co. Inc) at room temperature until dissolution was achieved. The liquid was decanted, the residue washed several times with toluene and filtered. The air-dried residue consisted of small irregular pale and dark particles of different size.

RESULTS AND DISCUSSION

In order to demonstrate the occurrence of shotgun pellets or bullets in wild animals when wounded or when ingestion of lead shot is suspected, at our Institute X-ray photographs are taken routinely. White spots on a dark background identify X-ray-dense material in the carcase. The same technique was applied when repeated lead analysis of liver and kidney tissues gave irreproducible results. Differences between 0.1 (or lower) and over 100 mg lead per kilogram wet tissue were obtained, as shown in Table 1.
TABLE 1
LEAD CONCENTRATIONS FOUND IN LIVER AND KIDNEY TISSUES OF LONG-TAILED DUCK (CLANGULA HYEMALIS) AND COMMON EIDER (SOMATERIA MOLLISIMA) KILLED BY SHOTGUN PELLETS (The renal lead concentrations are high compared with that in the livers and are not reproducible)

<table>
<thead>
<tr>
<th>Figure No.</th>
<th>Species</th>
<th>Lead concentration (mg kg(^{-1}) wet wt.)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Liver</td>
</tr>
<tr>
<td>1</td>
<td>Long-tailed duck</td>
<td>0.11 22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.01 1.7</td>
</tr>
<tr>
<td>2</td>
<td>Common eider</td>
<td>0.11 0.55</td>
</tr>
<tr>
<td>3</td>
<td>Common eider</td>
<td>0.09 0.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.14 15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.10 59</td>
</tr>
</tbody>
</table>

Organ tissues in which X-ray-dense particles were present are illustrated in Figs 1a, 2a and 3a (cf. Table 1). Figure 4, a reference photograph of kidney tissue without any contamination, is shown for comparison.

The particles separated from the corresponding tissue samples are shown in Figs 1b, 2b and 3b. The pale particles in Figs 1b and 2b are bone fragments and can easily be distinguished from the dark lead particles, which arose by disruption of lead pellets upon collision with bone tissue. Figure 3b shows half of a pellet isolated from a kidney.

The origins of the dark fragments, i.e. lead pellets, were confirmed by chemical analysis. Most of the particles consisted of lead. Lead fragments in tissues from shot wild ruminants have recently been observed (H. Hecht, personal communication, 1985).

CONCLUSION

When organs and tissues from wild animals, such as birds, have to be analyzed for lead and shooting is suspected, it is advisable to take X-ray photographs prior to the lead analysis. If contamination is demonstrated, it is recommended not to analyze for lead. Nevertheless, if analysis has to be performed, the parts of the tissues chosen should be free from fragments; the risk of contamination by finely divided and hardly visible fragments cannot be eliminated. Determination of lead should be performed on at least two different samples of the tissue examined.
Fig. 1. (a) X-ray photograph of kidney from long-tailed duck. The white spots are X-ray-dense particles. (b) Particles separated after dissolution of kidney tissue from long-tailed duck. Dark particles are fragments from lead pellets; the pale-coloured particles originate from bone tissue.
Fig. 2. (a) X-ray photograph of kidney from eider duck. The white spots are X-ray-dense particles. (b) Particles separated after dissolution of kidney tissue from eider duck. Dark particles are fragments from lead pellets; the pale-coloured particles originate from bone tissue.
Fig. 3. (a) X-ray photograph of kidney from eider duck. The white spots are X-ray-dense particles. (b) Particles separated after dissolution of kidney tissue from eider duck. Dark particles are fragments from lead pellets. Note shotgun pellet.
Fig. 4. X-ray photograph of kidney from eider duck free from X-ray-dense particles.

In environmental control programs, collection of animal samples by shooting often occurs; it is therefore important to be aware of the risks of lead contamination to avoid misleading analytical results and false conclusions.

REFERENCES