Bull. Environm. Contam. Toxicol. 26, 652-655 (1981)

Tissue Lead Concentrations in Japanese Quail Ingesting Lead Pellets or Shot with Lead Pellets

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Data obtained from birds shot by hunters warrant the consideration that shooting with lead pellets may contribute to the quantity of lead detected in tissues. Information on the effects of shooting avian species with lead shot on tissue concentrations of lead is, therefore, of considerable importance in assessing the value of birds shot by hunters as a source of samples for studying lead contamination. KENDALL & SCANLON (1979) have reported on lead concentrations in tissues of mourning doves (Zenaida macroura) shot by hunters and used lead concentrations in livers and bones to delineate which doves had possibly ingested lead shot. KENDALL (1980) found that liver and bone lead concentrations of mourning doves were substantially increased after ingestion of a lead shot. SCANLON et al. (1980) reported that waterfowl shot by hunters and with direct evidence of ingested lead shot had significantly higher liver lead concentrations than did waterfowl without ingested lead shot.

As little information on the effects of shooting with lead projectiles on tissue lead concentrations exists, the present study was designed to measure the effects of shooting Japanese quail (Coturnix coturnix japonica) with lead pellets on lead concentrations in livers and in bones.

MATERIAL AND METHODS

Thirty adult male Japanese quail were used in the experiment (10 birds/treatment). Ten quail were each dosed with 1 number 8 lead pellet ($\bar{X}$± S. E. = 74± 2 mg/pellet). At 24 h after lead shot ingestion, these

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0007-4861/81/0026-0652 $01.00

individuals were sacrificed by decapitation. Ten quail received no lead shot (controls) and were sacrificed by decapitation. Ten birds were individually confined in paper bags, placed on a 120 cm post and shot from a range of 20 m with a 16 gauge shotgun using 28 g of number 8 lead shot. These birds died instantly. An average of 7 shot penetrations were found in each quail breast and 5 of 10 birds had their livers penetrated by at least one shot. The liver and a femur were analyzed for lead concentrations using atomic absorption spectrophotometry (SCANLON et al. 1980). Homogenates of the entire liver from each bird were used.

Liver and bone lead concentrations were analyzed for equal response effects with a multivariate one-way analysis of variance (Wilks' Criterion Statistic; MORRISON 1976). Roy-Bose Simultaneous Confidence Intervals were used to delineate significantly different means (MORRISON 1976).

RESULTS

Mean bone and liver lead concentrations of control birds and birds shot by lead pellets were not different (Table 1). However, birds that ingested lead shot had liver and bone lead concentrations that were higher ($P<0.05$) than the other treatments.

Table 1. Means (±S.E.) of bone and liver lead concentrations of Japanese quail that were shot with lead pellets, that had ingested lead pellets and sacrificed after 24 h, and of controls.

	N	Bone lead (µg/g, dry weight)	Liver lead (µg/g, dry weight)
Control	10	1.3 ± 0.1^{a}	0.26 ± 0.52^{a}
Shot	10	2.3 ± 0.7^{a}	0.89 ± 0.13^{a}
One lead pellet ingested	10	11.1 ± 1.7^{b}	11.4 ± 3.6^{b}

^{a}, ^{b}Those means in the same column followed by a different superscript are significantly different ($P<0.05$).

Figure 1 presents a plot of bone lead versus liver lead concentrations for all treatments. Data points for control birds and for birds shot with lead pellets were with one exception tightly clustered with values below 2.5 µg/g bone lead and below 2.0 µg/g liver lead. Values for birds that ingested lead shot were with one exception considerably higher (10.0 µg/g liver lead or

greater, while bone lead was higher than 6.0 µg/g). One bird that ingested a lead pellet had liver lead and bone lead values of 2.5 and 1.7 µg/g, respectively. The lead pellet recovered from the gizzard had only 1.1 mg of lead eroded.

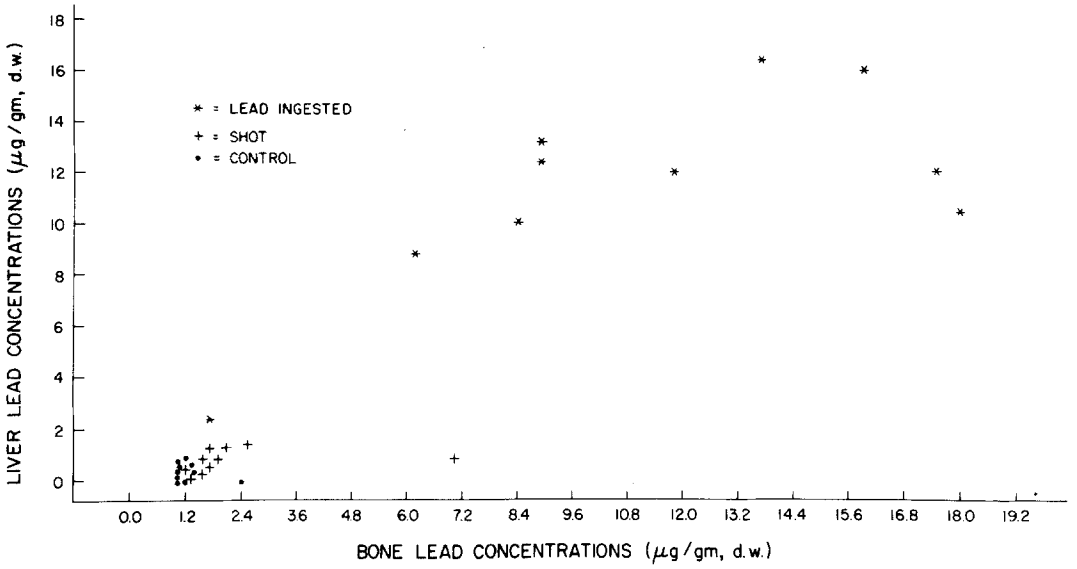

Fig. 1. Bone versus liver lead concentrations in Japanese quail that ingested 1 number 8 lead pellet and were sacrificed at 24 h after lead shot ingestion, shot with lead pellets, or sacrificed as controls.

DISCUSSION

Bone and liver lead concentrations in Japanese quail were not significantly increased over control values by shooting with lead shot while lead shot ingestion resulted in higher bone and liver lead concentrations. Femurs selected had not been hit by lead shot. However, livers were penetrated in 5 of 10 birds shot. SZYMCZAK & ADRIAN (1978) collected 10 geese which were described as gunshot victims and had crippled wings, Chemical analyses for lead in the liver, kidney and bone tissue indicated lead concentrations within the normal range. Lead shot which enter the bodies of birds and lodge in tissues are thought to be encapsulated in surviving birds. Acute lead poisoning in a bird as a result of lead contamination from a non-killing lead missile has not been reported. However, in humans the reverse is true. DILLMAN et al. (1979) reported a case history of a man who exhibited symptoms of lead intoxication as a result of a gunshot wound. The lead projectile was lodged in the hip joint which resulted in synovial fluid dissolution. These investigators also reviewed 5 confirmed cases of lead poisoning resulting from buckshot

wounds. Lead intoxication was detected on the average, 3 months after entry of buckshot.

It appears that avian species which are shot with lead pellets can be a reliable source of samples for monitoring contamination. Bone lead can be dramatically increased if hit by a lead pellet. Particular care should be utilized in obtaining bone samples from hunter-killed birds. Lead shot penetrations of soft tissue, such as the liver, did not appear to significantly increase lead concentration. However, quail which have ingested lead shot were readily distinguished by both liver and bone lead concentrations from those which have not, even when the lead shot was ingested as little as 24 h before sampling.

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Accepted March 11, 1981