

Residues of 4-Aminopyridine in Poisoned Birds

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4-Aminopyridine (4-AP) is a chemical used to frighten birds and thus protect ripening crops, food establishments or buildings from depravation and despoiling (DeGRAZIO et al. 1971, 1972; MOTT & ROYALL 1975, KNITTLE et al. 1974). 4-AP is used as a bait after being coated on a suitable food substitute such as mixed grains or cracked corn kernels. After ingestion the compound causes the bird to become disoriented and emit distress calls that frighten away the rest of the flock. A small percentage of birds ingest enough to die.

METHODS AND MATERIALS

Dead or dying birds were collected around sites where 4-AP had been used to discourage birds at food processing plants and hospitals between 1976 and 1978. The concentrated bait consisted of mixed cereal grains or cracked corn (Zea mays) treated with 0.5% of the HCl salt of 4-AP. Baiting stations consisted of a platform located on roofs or high places on the buildings. The 0.5% bait was mixed with untreated grain to reduce the concentration to 0.03%.

Birds were dissected and their tissues were analysed by analytical procedures originally described by PETERSON (1971, 1975) for plant tissues but herein modified slightly for animal tissues.

RESULTS

Birds were collected at varying distances from the feeding stations. House sparrows (Passer domesticus) and domestic pigeons (Columba livia) were collected on the premises of the treatment sites while herring gulls (Larus argentatus) were collected between the site and 5 km away. Pigeons, sparrows and the redwing black-bird (Agelaius phoeniceus) died within a few minutes of consumption however, some survived incapacitated for up to 90 min.

The treated cracked grains contained an average of 18 mg/kg of 4-AP, the intended concentration of the mix was 30 mg/kg. However, samples of the grain analysed were collected 1-3 days after being set out as baits and hence residues of 4-AP could have declined.

The contents of the crop, proventriculus and gizzards of all four species of birds ranged from 0.5 - 92 mg/kg. However, one herring gull and one pigeon appeared to have selectively consumed more treated grain than others leading to very high levels of 4-AP in the crop, proventriculus and gizzard. In the remaining birds these parts of the alimentary canal contained residues that ranged from 0.5 to 22 mg/kg and were in keeping with the baited grain levels of 11 to 26 mg/kg.

In the short period between consumption and death 4-AP appeared in all tissues throughout the birds. Residue levels appeared quite uniform and no brain barrier to this compound was evident. In the case of house sparrows death appeared to occur at lower concentrations (0.8 - 1.9 mg/kg) than with the other species (2.8 - 7.6 mg/kg).

The lethal dose for herring gulls and domestic pigeons was very similar at 4.0 and 4.4 mg/kg of body weight respectively (Table 2). The lethal dose for house sparrows was lower at 1.4 mg/kg. SCHAFFER et al. (1978) reported that the sensitivity of birds to 4-AP showed no obvious differences between species or genera when variables such as carrier and chemical form were disregarded. SCHAFFER et al. (1973) recorded a LD₅₀ of 8 (neutral 4-AP) for *Larus delawarensis* (ring-billed gull), an LD₅₀ of 20 (4-AP-HCl) and 7.5 (neutral 4-AP) for common pigeon, an LD₅₀ of 3.2 (4-AP-HCl) and 2.4 and 8.5 (neutral 4-AP) for redwinged blackbird and 3.6 to 7.0 (neutral 4-AP) for the house sparrow.

The concentration in the bait (11-26 mg/kg) was lethal to some members of the species, however, the percentage of those feeding and not dying was unknown hence a LD₅₀ could not be calculated. These concentrations in the baits were much lower than the 28 day LC₅₀ values reported by SCHAFFER et al. (1975) for male coturnix quail (*Coturnix coturnix*) at 450 ppm and for females at 560 ppm in the total diet.

TABLE 1. Residues of 4-aminopyridine in birds collected dead or dying following ingestion of treated cracked corn

Substrate	Number of Samples	Mean (mg/kg)	SD (mg/kg)	Range (mg/kg)
Treated Grain	7	18	6	11 - 26
Herring Gull				
Crop & Gut Contents	10	17	33	2.2 - 92 ¹
Livers	10	3.4	0.9	2.7 - 5.2
Hearts	4	3.0	0.4	2.7 - 3.8
Muscle	5	4.3	1.4	2.2 - 5.9
Kidney	6	3.8	1.7	2.1 - 5.1
Brains	5	2.8	1.0	1.7 - 4.1
Lungs	2	4.8	1.3	3.9 - 5.7

(cont'd.)

TABLE 1 (cont'd.)

Substrate	Number of Samples	Mean (mg/kg)	SD (mg/kg)	Range (mg/kg)
Wild Pigeons				
Crop & Gizzard Contents	6	21	33	0.5 - 78 ¹
Liver	4	4.6	4.3	1.4 - 10.8
Muscle	3	4.2	3.4	0.3 - 6.3
Kidney	3	5.9	1.8	4.6 - 7.2
Brain	4	4.8	4.1	2.4 - 9.6
House Sparrow				
Crop Contents	2	5.8	1.8	4.5 - 7.1
Liver	2	1.9	1.4	0.9 - 2.9
Muscle	2	1.3	1.1	0.5 - 2.1
Brain	2	0.8	0.6	0.4 - 1.2
Redwing Blackbird				
Crop & Gut Contents	1	15		
Muscle	1	7.6		

¹Second highest levels in gulls was 22 mg/kg and in pigeons 20 mg/kg

TABLE 2. Mean contents and lethal doses of 4-aminopyridine in three species of birds that died after consuming the bait ad lib at feeding stations. 1976-78

Item	Herring Gulls		Wild Pigeons		House Sparrows	
	Wt(g)	ug 4-AP	Wt(g)	ug 4-AP	Wt(g)	ug 4-AP
Skeleton, Skin & Feathers	190		110		7	
Brain & Spinal Column	25	70	15	70	1	0.8
Internal Organs	115	390	50	270	4	7.6
Alimentary Canal	50	210	30	120	2	2.6
Muscle	315	1400	220	900	12	16
Stomach & Crop Contents	55	960	30	630	2	12
TOTALS - Whole Body	750	3000	450	2000	28	38

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