IS THE USE OF DCR-1339 HUMANE?

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Is DRC-1339 a species-specific toxicant?

3-Chloro-p-toluidine hydrochloride (3-chloro-4-methylbenzenamine hydrochloride; 3-chloro-4-methylaniline hydrochloride; DRC-1339) is a slow-acting selective avicide. The toxic dose is highly variable across species. It is very highly toxic to some families of birds and to cats, but only slightly to moderately toxic for many other avian families and most mammals. These descriptions have a specific meaning in the classification scheme used by the USEPA, which is adopted here. They are given in **Table 1**. Although in some cases studies of the response of a species to DRC-1339 have resulted in significantly different LD_{50} values, the range has always been within one of these descriptive classifications[1].

Table 1. USEPA toxicity definitions

Description	LD_{50}
Very highly toxic	<10 mg/kg
Highly toxic	10-50 mg/kg
Moderately toxic	51-500 mg/kg
Slightly toxic	501-2,000 mg/kg
Practically nontoxic	>2,000 mg/kg

Does DRC-1339 cause pain?

DRC-1339 is the most extensively tested of all avicides and large numbers of studies have been conducted in a wide range of avian species, as well as mammals. It has been noted that birds may be thirsty and seek water prior to death[2] (a consequence of renal failure; see ***Mode of action*** below), but this is the only adverse effect recorded. Birds that ingested a lethal dose of the compound died a quiet death; there was no flapping, convulsing, vocalisation or any other indication of pain or distress[3,4]. Rooks and pheasants that died 32-80 hours after ingestion of a single oral dose of DRD-1339 did so

[1] Eisemann JD, Pipas PA, Cummings JL. Acute and chronic toxicity of compound DRC-1339 (3-chloro-4-methylaniline hydrochloride) to birds. Management of North American Blackbirds. Linz GM, Editor. Proceedings of a special symposium of The Wildlife Society 9th Annual Conference, Sept 27 2002, Bismarck, N Dakota http://www.aphis.usda.gov/ws/nwrc/symposia/blackbirds/eisemann.pdf.

[2] Samuel MD, Goldberg DR and Rocke TE. (2002) The risk of avian botulism outbreaks from avicide DRC-1339 in North Dakota wetlands. 51st Annual Wildlife Disease Association Conference, Humboldt State University.

[3] Eisemann JD. Personal communication

[4] Williams DE and Corrigan RM. (1994) Prevention and control of wildlife damage: pigeons. www.wildlifedamage.unl.edu

in coma[5]. Individuals and organisations do claim that the toxicant is inhumane, but these claims – which are found in increasing numbers on the internet - are not supported by evidence.

How long does it take for birds to die?

The time to death after ingestion of DRC-1339 depends on the sensitivity of the species and the dose consumed. Birds respond to DRC-1339 as most living organisms respond to the majority of toxic compounds, in that the higher the dose the more rapid the death. Most deaths occur 3-50 hours after ingestion, but they are recorded for up to 80 hours[6]. Baiting design is optimised to deliver a lethal dose to the target species with minimal consumption of the bait, and thereby to hasten death as much as possible.

If birds eat a sub-lethal dose, does this result in chronic damage?

Birds that survive ingestion of DRC-1339 do not appear to suffer from chronic toxicity. Studies have been conducted in which oral doses of 0, 1.0, 2.0 and 3.0 mg/kg DRC-1339 were administered to 20 starlings, 5 at each dose. Four birds died within 50 hours of ingestion, one from a 2.0 mg/kg dose and three from the 3.0 mg/kg dose. No further mortality occurred during the remaining 26 days of the study[7]. In a separate study no changes were found in the gross and microscopic pathology of rooks and pheasants that survived a single oral dose of 0.7-1.0 and 7.0-10.0 mg/kg respectively[8].

What is the risk to non-target species?

Numerous studies have shown that this toxicant poses a minimal risk of either primary or secondary poisoning to non-target species. The risk depends on the sensitivity of a species to the toxicant and the likelihood that it will consume the bait. The sensitivities of 22 families of birds to DRC-1339 are given in **Table 2.**

In Australia, the families known to be most sensitive are the corvids, pigeons and doves, quail, gulls, ducks and swans, and members of the family Icteridae, which includes starlings and common mynas. Several of these may be target species, and the risk to highly sensitive non-target species may be minimised by designing the bait and its presentation so that it is unattractive and inaccessible to these birds.

Consumption of DRC-1339 by birds and mammals that are relatively insensitive to the toxicant is also minimised by approaches to bait design, and also to the dose of toxicant on each bait. In the majority of cases a relatively insensitive bird or mammal would not consume sufficient bait to be killed, and there is no evidence for long-term effects of

[5] Nikodemusz E and Imre R. (1982) Pathological features of 3-chloro-4-methyl benzamine HCl toxicity in rooks (*Corvus frugilegus* L.) and pheasants (*Phasianas colchicus* L.). Gegenbaurs Morphol Jahrb. 128, 753-61.

[6] Nikodemusz E and Imre R. (1982). Pathological features of 3-chloro-4-methyl benzamine HCl toxicity in rooks (Corvus frugilegus L.) and pheasants (Phasianas colchicus L.). Gegenbaurs Morphol Jahrb. 128, 753-61.

[7] Eisemann JD, Pipas PA, Cummings JL. Acute and chronic toxicity of compound DRC-1339 (3-chloro-4-methylaniline hydrochloride) to birds. Management of North American Blackbirds. Linz GM, Editor. Proceedings of a special symposium of The Wildlife Society 9th Annual Conference, Sept 27 2002, Bismarck, N Dakota http://www.aphis.usda.gov/ws/nwrc/symposia/blackbirds/eisemann.pdf.

[8] Nikodemusz E and Imre R. (1982). Pathological features of 3-chloro-4-methyl benzamine HCl toxicity in rooks (Corvus frugilegus L.) and pheasants (Phasianas colchicus L.). Gegenbaurs Morphol Jahrb. 128, 753-61.

DRC-1339 ingestion in these species. It is relevant that DRC-1339 appears to have different modes of action in highly sensitive and relatively insensitive species (see below).

The compound is metabolised and excreted from all animals very quickly, with 90% or more lost within 2 hours. A recent study showed that ^{14}C-labelled DRC-1339 that became localised in the tissues was also eliminated rapidly, except from the kidneys[9]. Most metabolites are much less toxic than the primary compound. DRC-1339 does not accumulate in the body, and residues in the carcass generally range from zero to less than 0.1 ppm. This rapid excretion markedly reduces the risk of any secondary poisoning by consumption of carcasses.

Table2. Sensitivities of 22 families of birds to DRC-1339

Family	Number of studies	Number of species	LD_{50} (mg/kg)
Passeridae	1	1	375
Falconidae	1	1	>320
Psittacidae	1	1	242
Alaudidae	1	1	232
Accipitridae	5	4	100 - 562
Fringillidae	3	3	>32 - >225
Cracidae	1	1	42.1
Ploceidae	7	5	31.6 - 562
Anatidae	5	3	17.8-161
Pycnonotidae	1	1	6.7
Tytonidae	1	1	4.2
Emberizidae	4	3	3.5 - >320
Mimidae	2	2	≥3.2
Columbidae	8	5	3.2 - 20
Turdidae	1	1	3.2
Phasianidae	9	3	3.0 - 10.26
Cardinalidae	1	1	<3.2
Odontophoridae	5	3	2.4 - 4.2
Laridae	2	1	1.5 - 4.6
Corvidae	8	7	1.33 - 13
Sturnidae	3	1	1.33 - 3.8
Icteridae	9	6	<1.0 - 5.62

The aquatic and invertebrate toxicity of DRC-1339 is low. Moreover, it is unstable in the environment and degrades rapidly when exposed to heat, sunlight or water. This further minimises the risk of secondary poisoning.

How does DRC-1339 work?

DRC-1339 appears to have different modes of action in more susceptible and less susceptible species. The biochemical mechanism behind its toxicity is not definitively

[9] Goldade DA, Tessari JD and Johnston JJ. (2004). Absorption, distribution and excretion of [14C]-3-chloro-4-methylaniline hydrochloride in two species of birds following a single oral dose. J Agric Food Chem 52, 8074-80.

understood for any animal, but there is considerable support for the view that renal deacetylase has an important role in the sensitivity of species to this compound[10]. Relatively insensitive mammals and raptors do not have mitochondrial renal deacetylase, whereas highly sensitive birds do. In more susceptible species DRC-1339 causes renal failure. Uric acid deposits build up in the cardiovascular system causing necrosis and circulatory impairment, and leading to nephrotoxicity, uraemic poisoning and congestion of major organs. A quiet death follows 3-80 hours after ingestion, depending on the dose consumed. A study of the gross and microscopic pathology of DRC-1339 toxicity after a single oral dose in rooks and pheasants showed extensive parenchymal degeneration of the kidney, fatty degeneration of the liver and congestion of the major organs in birds that died within 18 hours of ingestion of the toxicant. In birds that died later there were deposits of uric acid crystals on the serosal surfaces of various organs[11]. This resembles avian visceral gout, which is a non-specific condition following renal failure in birds. Methaemoglobinaemia is not believed to be a primary contributor to death, except possibly in cats.

In less susceptible species, which should not receive a toxic dose if DRC-1339 is appropriately administered (see below), there appears to be a different mechanism of response to high doses of DRC-1339, with depression of the central nervous system resulting in cardiac or respiratory arrest. In mammals and raptors this has been successfully treated symptomatically, but it should be noted that incidence of this form of toxicity in species that are only moderately or slightly sensitive to DRC-1339 should be minimised by appropriate application of baits. DRC-1339 does not appear to affect avian reproduction except at levels very close to those at which toxicity occurs.

Summary

1. DRC-1339 is a selective toxicant that is very highly toxic to some families of birds and to cats, but only moderately or slightly toxic to other birds and mammals as well as to fish and invertebrates.
2. After ingestion of DRC-1339, birds may be thirsty and seek water but do not display other signs of distress. They die a quiet, non-convulsive, sometimes comatose death, without flapping, vocalisation or any other sign normally associated with pain or distress, 3-80 hours later.
3. Birds that survive ingestion of DRC-1339 show no signs of pathology at either the gross or the microscopic level. Survival studies have been conducted up to 28 days after ingestion. There is no evidence for chronic damage from ingestion of this toxicant.
4. Avian species that are highly sensitive to DRC-1339 probably die of renal failure. It appears to depress the central nervous system in moderately and slightly sensitive species, but any such effect can be minimised by appropriate design and application of baits.

[10] Eisemann JD, Pipas PA, Cummings JL. Acute and chronic toxicity of compound DRC-1339 (3-chloro-4-methylaniline hydrochloride) to birds. Management of North American Blackbirds. Linz GM, Editor. Proceedings of a special symposium of The Wildlife Society 9th Annual Conference, Sept 27 2002, Bismarck, N Dakota http://www.aphis.usda.gov/ws/nwrc/symposia/blackbirds/eisemann.pdf.
[11] Nikodemusz E and Imre R. (1982). Pathological features of 3-chloro-4-methyl benzamine HCl toxicity in rooks (Corvus frugilegus L.) and pheasants (Phasianas colchicus L.). Gegenbaurs Morphol Jahrb. 128, 753-61.

Disclosure

This report was prepared by Professor Joan Dawes, who is a professional biochemist, volunteer animal welfare worker, and Member of the Board of Directors of the Invasive Animals Cooperative Research Centre, Canberra.

Prof. Dawes is also Chairman of the Board of Directors of Pestat Pty Ltd, a bioscience company based in Canberra, Australia (www.pestat.com.au). This report was prepared by Prof. Dawes on behalf of Pestat Pty Ltd, which has commercial interests in assessment and use of the toxicant for pest bird management.