

BRODIFACOUM RESIDUES IN POSSUMS (*TRICHOSURUS VULPECULA*) AFTER BAITING WITH BRODIFACOUM CEREAL BAIT

Summary: The presence of brodifacoum residues in possum (*Trichosurus vulpecula*) livers following routine possum control was investigated. Possums were poisoned in six nature reserves in the Wellington Region, New Zealand, using cereal baits containing 20 mg kg⁻¹ brodifacoum dispensed from bait stations. Thirty-five surviving possums, and five dead possums were sampled from the reserves following poisoning, and their livers analysed for the presence of brodifacoum. The majority (83%) of samples contained brodifacoum at concentrations ranging from 0.007 mg kg⁻¹ to 6.2 mg kg⁻¹. The presence of significant quantities of brodifacoum in possum carcasses following poisoning operations creates potential for secondary and tertiary poisoning of non-target species.

Keywords: Brodifacoum; residues; possum; *Trichosurus vulpecula*.

Introduction

Brodifacoum is a commonly used toxin for possum (*Trichosurus vulpecula* Kerr) control in New Zealand (Eason, Wright and Batcheler, 1996). Its widespread use is largely due to the fact that operators do not need a license to use 20 mg kg⁻¹ brodifacoum cereal baits, an antidote is available and the perceived risks to humans and domestic animals are low.

Brodifacoum is a slow acting poison, and possums could therefore eat more than a lethal dose before death, which can take more than two weeks (Eason *et al.*, 1996). As brodifacoum from a single dose is known to be retained in mammalian livers for many months (Laas, Forss and Godfrey, 1985; Bachmann and Sullivan, 1983), brodifacoum consumed at monthly intervals is thought to accumulate in possum tissues, eventually killing them when an adequate concentration is reached. Although earlier literature indicates an LD₅₀ for brodifacoum in possums of 0.17 mg kg⁻¹ (Godfrey, 1985), it has been suggested that this is estimate is too low, and that the true LD₅₀ may be twice as high (Eason *et al.*, 1994). Repeated dosing of rats with flocoumafen, a close relative of brodifacoum, has demonstrated that concentrations in the liver of rats will increase to a saturation point of 3 to 5 mg kg⁻¹ at which time lethal anti-coagulant effects will occur in most animals (Huckle, Hutson and Warburton, 1988). Accordingly, possum control operators commonly dispense brodifacoum baits at intervals ranging from 2-4 weeks.

This study investigates the presence of brodifacoum in the livers of possums following application of cereal bait containing 20 mg kg⁻¹ brodifacoum during routine possum control in six nature reserves in the Wellington Region of New Zealand. The potential for secondary and tertiary poisoning of non-target species is discussed.

Methods

Possum control in six nature reserves of the Wellington Region

Possums are routinely controlled in the Wellington Region by the Wellington Regional Council or the Department of Conservation using cereal bait containing 20 mg kg⁻¹ brodifacoum dispensed via bait stations. Bait stations are typically distributed through control areas in a grid pattern at a spacing of 100-150 m. Brodifacoum cereal bait is replaced in the bait stations at approximately monthly intervals until bait consumption is reduced to low levels. Maintenance control may then be undertaken at 6-12 monthly intervals using further applications of brodifacoum cereal bait in the same bait stations.

Possum control as described in the previous paragraph was undertaken in six nature reserves in the Wellington Region, and relevant information relating to these six areas is presented in Table 1. The bait application rates are reported in Table 1 as bait applied ha⁻¹ year⁻¹ irrespective of the actual duration of bait application.

Table 1: Details of six nature reserves where possums were controlled using brodifacoum cereal bait.

Nature Reserve	Location (NZMS 260)	Area (ha)	Start Date Control	Bait applied (kg ha ⁻¹ year ⁻¹)
Battle Hill	2672600 6015500	33	November 1997	18.0
Hemi Matenga	2686000 6036000	331	March 1995	4.2
Maidstone Park	2684500 6006500	30	January 1998	14.6
Nga Manu	2683500 6035800	39	July 1997	3.2
Papaitonga	2699000 6060000	111	July 1996	2.5
Porirua	2663000 6006500	290	August 1996	5.2

Table 2: Brodifacoum concentrations in livers of possums recovered live or dead from areas subjected to possum control using 20 mg kg⁻¹ brodifacoum bait.

Nature Reserve	Date of sample	Body Mass (kg)	Sex	Collected alive or dead	Brodifacoum (mg kg ⁻¹) in liver
Battle Hill	13-May-98	2.8	M	alive	0.2
Battle Hill	13-May-98	1.6	M	alive	0.49
Battle Hill	23-Nov-97	3.0	F	dead	1.2
Hemi Matenga	10-Mar-97	1.3	F	alive	ND
Hemi Matenga	10-Mar-98	2.3	F	alive	ND
Hemi Matenga	10-Mar-98	3.0	F	alive	ND
Hemi Matenga	10-Mar-98	3.5	M	alive	ND
Hemi Matenga	10-Mar-98	2.1	M	alive	0.009
Hemi Matenga	10-Mar-98	3.0	M	alive	0.026
Hemi Matenga	10-Mar-98	3.5	M	alive	0.029
Hemi Matenga	10-Mar-98	3.1	F	alive	0.048
Hemi Matenga	10-Mar-98	2.6	M	alive	0.101
Hemi Matenga	10-Mar-98	2.4	F	alive	0.145
Hemi Matenga	10-Mar-98	1.0	M	alive	0.25
Maidstone Park	19-Feb-98	2.3	F	alive	0.01
Maidstone Park	19-Feb-98	1.8	M	alive	0.32
Maidstone Park	19-Feb-98	3.3	M	alive	2.6
Maidstone Park	19-Feb-98	3.0	M	alive	3
Maidstone Park	19-Feb-98	3.0	F	alive	6.2
Nga Manu	6-Apr-98	2.3	M	alive	ND
Papaitonga	10-Mar-98	2.8	M	alive	ND
Papaitonga	10-Mar-98	1.6	M	alive	ND
Papaitonga	10-Mar-98	1.8	M	alive	0.007
Papaitonga	10-Mar-98	2.8	M	alive	0.052
Porirua Scenic Reserve	5-Mar-98	2.0	M	alive	0.05
Porirua Scenic Reserve	1-Sep-97	3.0	F	alive	0.15
Porirua Scenic Reserve	1-Sep-97	3.5	F	alive	0.17
Porirua Scenic Reserve	1-Sep-97	3.0	F	alive	0.18
Porirua Scenic Reserve	1-Sep-97	2.5	F	alive	0.22
Porirua Scenic Reserve	1-Sep-97	3.0	M	alive	0.26
Porirua Scenic Reserve	1-Sep-97	3.5	M	alive	0.27
Porirua Scenic Reserve	1-Sep-97	3.0	F	alive	0.3
Porirua Scenic Reserve	1-Sep-97	3.2	F	alive	0.31
Porirua Scenic Reserve	1-Sep-97	2.5	F	alive	0.36
Porirua Scenic Reserve	1-Sep-97	3.5	F	alive	0.47
Porirua Scenic Reserve	5-Mar-98	2.0	M	alive	2.07
Porirua Scenic Reserve	24-Dec-97	3.0	F	dead	0.9
Porirua Scenic Reserve	19-Nov-97	2.3	F	dead	1.1
Porirua Scenic Reserve	21-Nov-97	2.5	F	dead	1.2

Determination of brodifacoum residues in possum livers following control

Possums were collected from the nature reserves following application of brodifacoum bait. Forty possums collected were either dead or alive, with live possums being captured by trapping or through the use of fast acting cyanide poison.

Livers were removed from the animals and analysed for presence of brodifacoum residues. Brodifacoum concentrations in the liver tissues of possums were determined by high performance liquid chromatography using a published method for determining brodifacoum residues (Hunter, 1983). Table 2 reports the date possums were sampled from the nature reserves, details of individual possums, and whether they were alive or dead prior to sampling.

Results

Residual brodifacoum concentrations for each possum liver are individually presented in table 2. The thirty five live sampled possums had a mean residual brodifacoum concentration of 0.52 mg kg⁻¹ and a range of "not detected" to 6.2 mg kg⁻¹. The five dead sampled possums had a mean residual brodifacoum concentration of 1.22 mg kg⁻¹ and a range of 0.9 mg kg⁻¹ to 1.7 mg kg⁻¹.

Discussion

This study has provided data on the residual concentrations of brodifacoum in livers of possums that can be expected following a typical control operation using brodifacoum cereal bait. The concentrations reported are significant, with the highest concentration of 6.2 mg kg⁻¹ being approximately one third of the concentration of brodifacoum in 20 mg kg⁻¹ brodifacoum cereal bait. Previous studies have shown that brodifacoum can be retained in substantial concentrations in possum liver for a period of at least eight months (Eason *et al.*, 1996).

The existence of significant and persistent residual concentrations of brodifacoum in possums livers creates a risk of secondary and tertiary poisoning, particularly of predatory and scavenging species. This study confirms the anticipated risks of secondary and tertiary poisoning described previously by Eason *et al.* (1996).

Alternative control options with lower associated non-target poisoning risks are available, including trapping, or poisoning using cholecalciferol or encapsulated cyanide baits. Exposure of predatory and scavenging species to brodifacoum may also be lowered where it is used against a possum population previously reduced by alternative methods.

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