

# Palatability of rodent baits to wild house mice

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# Palatability of rodent baits to wild house mice

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## ABSTRACT

There is a lack of species-specific information available on relative palatability and efficacy of rodent baits. This study begins to address this data gap by assessing the palatability and efficacy of four toxic rodenticide products to wild house mice (*Mus musculus*) in New Zealand. Groups of 20 mice were given a choice between 50 g of the toxic test bait and 50 g of non-toxic RS5 for 3 consecutive nights. PESTOFF® rodent bait was the most palatable bait tested and achieved 100% mortality, and Talon® 50WB was also palatable and effective. Although palatable, Racumin® paste was less effective and Talon® 20P appears unsuitable for mice control due to its poor palatability, which resulted in low mortality. In addition, the sensitivity to brodifacoum for the four rodent species (*Rattus norvegicus*, *R. rattus*, *R. exulans*, and *Mus musculus*) was determined. This indicated that the LD<sub>50</sub> in rodents ranged from 0.17 mg/kg to 0.52 mg/kg, which is comparable with the previously reported LD<sub>50</sub> for *R. norvegicus*.

**Keywords:** *Mus musculus*, rodenticides, brodifacoum, coumatetralyl, LD<sub>50</sub>, bait palatability.

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# 1. Introduction

The palatability and efficacy of four toxic rodenticide products to wild house mice was assessed by Landcare Research, Lincoln, for the Department of Conservation (DOC) to provide data on the feeding preferences of this species. The lethal dose range for brodifacoum for four rodent species, including the house mouse, was also determined.

## 2. Background

Efforts by DOC to eradicate introduced rodents from offshore islands using poisoned baits are often complicated by the lack of species-specific information available on bait palatability and efficacy. Anecdotal evidence suggests that Norway rats (*Rattus norvegicus*), ship rats (*R. rattus*), kiore (*R. exulans*) and house mice (*M. musculus*) may exhibit different feeding preferences for the various commercial rodent baits used in these poisoning operations, but controlled studies to verify this suspicion have not been conducted.

Discussions with DOC staff identified that the species they have greatest difficulty controlling or eradicating is the house or field mouse. Mice are considered to be the greatest threat to offshore islands because they are the most likely species to reinvade. Anecdotal evidence suggests that, in both mainland control and island eradications, mice have also been the most difficult of the rodent species to control.

In addition, most lethal-dose studies of rodenticides have been conducted with laboratory strains of rat and mice. The published LD<sub>50</sub> for the laboratory Norway rat is 0.27 mg/kg (Worthing & Hance 1991). Little is known about potential species-specific differences in sensitivity to the toxicants commonly used to control wild rodents in New Zealand. This information, along with species-specific data on the palatability of different bait matrixes, is crucial to formulating baits that maximise the kill of the target species and may also be useful for minimising non-target impacts.

## 3. Objectives

- To determine the palatability and efficacy of four rodenticide products to wild house mice in captivity.
- To determine if the lethal dose range for brodifacoum reported in the literature adequately represents the sensitivity of wild rodents in New Zealand.

## 4. Methods

### 4.1 BAIT PALATABILITY AND EFFICACY TO MICE

Wild-caught house mice (*Mus musculus*) were housed at the Landcare Research animal facility in individual cages containing shredded paper for play and nesting, and fed *ad libitum* on rat and mouse pellets (Western Milling Co, Rangiora). Supplementary food (a piece of apple) was provided and water was available at all times. Mice were allowed a minimum of 14 days acclimatisation and were weighed prior to testing.

Toxic baits tested were PESTOFF® pelleted cereal baits for rodents (brodifacoum), Talon® 50WB wax blocks (brodifacoum), Racumin® paste (coumatetralyl), and Talon® 20P pelleted cereal bait (brodifacoum). This selection was made after consulting DOC scientists. All baits were used in trials within 6 weeks of manufacture. The two cereal pellet baits were analysed for brodifacoum content based on the method of Hunter (1983). This method has a limit of detection of 0.7 µg/g.

Batches of 20 mice were caught and tested at different times, with the same toxic bait being assigned to all mice in a batch. It is therefore an assumption of the study that there were no underlying differences in bait preferences between the four batches. We believe this to be a reasonable assumption. In a choice-test procedure, mice were presented with 50 g of the toxic test bait and 50 g of the industry-standard bait (non-toxic RS5, Animal Control Products, Waimate), for 3 consecutive nights (note: mice were fed Racumin® paste for 5 consecutive nights, which is the standard procedure for efficacy testing of a first-generation anticoagulant product).

Palatability was defined as the weight of test bait eaten, expressed as a percentage of both bait types eaten. Time to death was recorded, and at 21 days any surviving animals were euthanased humanely. Daily palatability for the four baits was analysed by repeated measures analysis of variance (ANOVA). The overall mean palatabilities for the four baits were compared using Bonferroni pairwise comparisons.

### 4.2 LETHAL DOSE RANGE FOR BRODIFACOUM

Eighteen wild house mice and 20 wild Norway rats were caught in live traps in Canterbury. Sixteen wild ship rats were live trapped on the West Coast, and 20 kiore were provided by the Ngati Wai Trust Board, Whangarei. All animals were obtained from brodifacoum-free areas and acclimatised for a minimum of 1 week at the Landcare Research animal facility. The rats were caged individually and given *ad libitum* access to water and a mixed diet of grains and fruit to simulate their natural diet.

Individual animals of each species were weighed and randomly allocated to five groups of three to four animals, depending on numbers available. The ship rats were randomly allocated to four groups of four animals. Individuals were given

a single oral dose of brodifacoum by gavage, with the dose range chosen to bracket the expected LD<sub>50</sub> values. Animals were dosed with 5 ml of 0.84% w/v brodifacoum (in monopropylene glycol (MPG)) per kilogram body weight. The animals were returned to their normal diet 24 hours after dosing, and were monitored for 2 weeks post-dosing. The number of animals in each dose group that died was recorded, and the data used to estimate species-specific LD<sub>50</sub> values for brodifacoum by probit analysis (Finney 1971). The LD<sub>50</sub> is the concentration of pesticide that kills 50% of the sample population.

## 5. Results

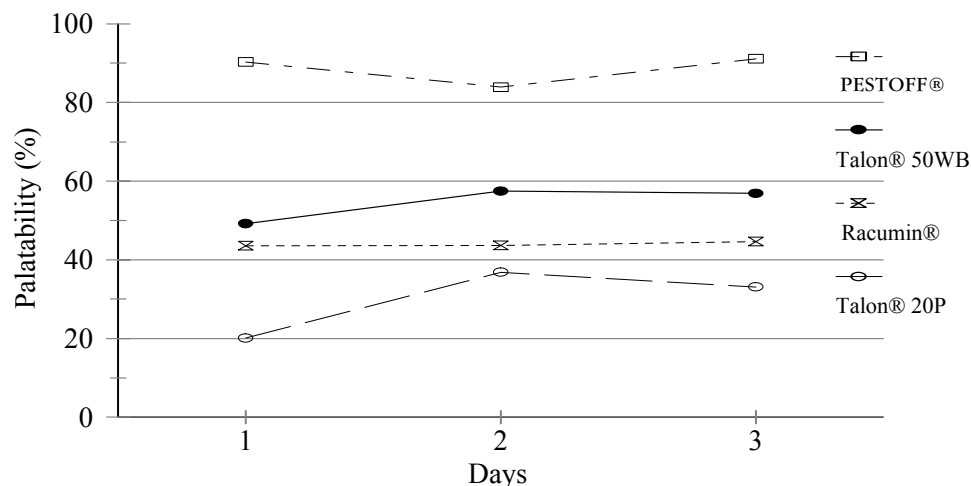
### 5.1 BAIT PALATABILITY AND EFFICACY TO MICE

The total weight of PESTOFF® bait eaten over the 3 test days was 11.34 ± 0.60 g/mouse (mean ± s.e.m) compared with 1.31 ± 0.18 g/mouse of control bait. Hence, the mice showed a preference for PESTOFF®, eating 89% of the total bait intake as PESTOFF® bait. There was 100% mortality with a mean time to death of 9.9 days (range: 6–18 days). The PESTOFF® bait contained 21.5 µg/g brodifacoum.

The total weight of Talon® 50WB bait eaten over the 3 test days was 12.53 ± 2.54 g/mouse compared with 8.92 ± 0.87 g/mouse of control bait. Hence, the mice showed little preference between the baits, eating 53% of the total bait intake as Talon® 50WB bait. There was 100% mortality with a mean time to death of 10.7 days (range: 5–17 days).

The total weight of Racumin® bait eaten over the 5 test days was 5.59 ± 0.7 g/mouse compared with 10.47 ± 1.74 g/mouse of control bait. Hence, the mice showed little preference between the baits, eating 41% of the total intake as Racumin® bait (palatability 42% over 3 days; Fig. 1). There was 50% mortality with a mean time to death of 6 days (range: 3–8 days).

Figure 1. Palatability to mice of the four different bait types, over 3 days. A value of 50% indicates equal palatability with the 'control' bait, RS5 pellets.





The total weight of Talon® 20P bait eaten over the 3 test days was  $3.2 \pm 0.68$  g/mouse compared with  $8.08 \pm 0.90$  g/mouse of control bait. Hence, the mice showed a preference for the control bait (RS5), eating only 30% of the total intake as Talon® 20P bait. There was 50% mortality with a mean time to death of 11.2 days (range: 5-17 days). Talon® 20P bait contained 21.7 µg/g brodifacoum.

There was a significant difference between bait types in palatability ( $F_{3,76} = 21.4$ ,  $P < 0.001$ ) which remained consistent over the 3 days of each test ( $F_{6,152} = 0.95$ ,  $P = 0.46$ ; Fig. 1). Overall, PESTOFF® bait was significantly more palatable than all other bait types ( $P < 0.001$ ) and Talon® 50WB was significantly more palatable than Talon® 20P bait ( $P = 0.014$ ).

## 5.2 LETHAL DOSE RANGE FOR BRODIFACOUM

Table 1 shows the LD<sub>50</sub> of brodifacoum calculated for each rodent species. These data show that Norway rats are the most susceptible species, followed by kiore, ship rats and house mice.

TABLE 1. LD<sub>50</sub> (mg BRODIFACOUM/kg BODY WEIGHT) FOR EACH RODENT SPECIES.

RODENT SPECIES	LD <sub>50</sub> (mg/kg)
Norway rat	0.17
Kiore	0.32
Ship rat	0.46
House mouse	0.52

## 6. Discussion

Of the four baits tested, PESTOFF® rodent bait was the most palatable, and was highly effective (100% mortality) in this cage study. As this bait is in a pellet form it would be suitable for both ground or aerial application. Wax-coatings can be applied to the bait, extending its field life and presenting various baiting strategy options. Palatability and longevity of the wax-coated pellets would first need to be assessed, as it is generally assumed that some loss of palatability is to be expected with these baits. However, in Britain wax baits have been shown to be palatable and effective to rats (Buckle 1994).

In assessing the palatability of baits to possums, if a bait forms at least 40% of the total food intake in a standard choice test with RS5, it is considered sufficiently palatable for field use (Henderson & Frampton 1999). If a similar palatability score (40%) was used in this trial with mice, PESTOFF® rodent bait, Talon® 50WB, and Racumin® paste would all be suitable baits for field use to control mice. However, Racumin® proved to have poor efficacy, suggesting that the threshold for acceptable palatability for mouse baits should be raised to 50%.

The deaths following poisoning with Racumin® occurred as early as 3 days after first exposure. This suggests that palatability should be assessed from bait consumption over 3 days, and not 5. However, this does not alter the current result, as overall palatability did not change whether measured over 3 or 5 days. Mice ate approximately a third less of Racumin® than of the two effective baits (PESTOFF® and Talon® 50WB), indicating that increased palatability of this product would be required for consistent consumption of a lethal dose by mice.

Talon® 20P appears unsuitable for mice control, with poor palatability resulting in a low mortality rate. This result contradicts an earlier finding where Talon® 20P was the preferred bait, compared with RS5 and a fishmeal cat bait (Morgan et al. 1996). This difference may be due to changes in bait formulations, or it may indicate variability between individuals and, possibly, populations of mice in food and bait preferences.

The brodifacoum-dosing trial showed that the LD<sub>50</sub> ranged from 0.17 mg/kg for the Norway rat to 0.52 mg/kg for the house mouse, but there was no significant difference between the four species of rodent. These values are comparable with the previously reported LD<sub>50</sub> for laboratory Norway rats (0.27 mg/kg).

## 7. Recommendations

- PESTOFF® rodent pellet bait was the most palatable bait tested and was very effective.
- Talon® 50WB was also palatable and effective for mice control.
- Racumin® paste and Talon® 20P are considered unsuitable for the control of wild mice.
- A minimum palatability of 50% is suggested as appropriate for wild mouse control, and palatability tests over 3 days are recommended.
- Bait specifications, including appropriate palatability measures, should be developed to ensure bait QA for mouse control work.
- The relative durability and palatability of PESTOFF® and Talon® 50WB after storage and under different environmental conditions (e.g. exposure to high temperature and humidity, or rain) needs to be determined.
- The relative palatability of commercially available rodent baits to the other wild rodent species (ship rats, Norway rats, and kiore) needs to be determined.

## 8. Acknowledgements

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