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The susceptibility of *Rattus rattus* and *Bandicota bengalensis* to a new anticoagulant rodenticide, flocoumafen

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SUMMARY

The anticoagulant rodenticide flocoumafen was evaluated against *Rattus rattus* and *Bandicota bengalensis*. In no-choice 24 h feeding tests 100% mortality occurred at 0·00125% concentration of the poison in the bait in the case of *B. bengalensis* and at 0·00375% in *R. rattus*. Feeding of 0·0025% poison bait in 1-day, no-choice and 2-day choice tests resulted in 60% and 75% mortality of *R. rattus*, respectively, and 100% of *B. bengalensis*. The differences between the consumption of plain food in the pretreatment period and of poison bait in no-choice tests were non-significant, except in one case. The rodents consumed significantly more ($P < 0·01$) poison bait than the plain alternative in the choice trials. Median period of survival and its 95% confidence limits of *R. rattus* and *B. bengalensis*, at the 100% mortality dose levels of the poison, were 6·3 (5·04–7·88) and 6·2 (4·92–7·81) days respectively.

Rodents affect the food supply of the world and communicate several diseases to human and livestock. For their control, there is an increasing interest in the evaluation and use of the 'second-generation' single-dose anticoagulant rodenticides like brodifacoum (Dubock, 1980; Parshad, Ahmad & Chopra, 1985), bromadiolone (Marsh, 1977; Meehan, 1978) and difenacoum (Lund, 1981). As compared to the first-generation multidose warfarin-type anticoagulants, the rodents are more susceptible to these poisons and require lesser feeding period and baits (Dubock, 1980; Lund, 1981; Parshad, Ahmad & Chopra, 1985). This communication reports the results of tests of two commonly occurring South Asian rodents, *Rattus rattus* and *Bandicota bengalensis*, to a new second-generation anticoagulant, WL108366, flocoumafen (Bowler, Entwhistle & Porter, 1984), which was developed by Shell Research Limited and supplied to us through National Organic Chemical Industries Limited New Delhi. It is a hydroxycoumarin compound with chemical name 3-[3-(4′-trifluoromethyl[1,1′-benzyloxyphenyl]-4-yl)-1,2,3,4-tetrahydro-1-naphthalenyl]-4-hydroxy-2H-benzopyran-2-one.

The house rat, *R. rattus*, and the Indian mole rat, *B. bengalensis*, were trapped from poultry farms and crop fields respectively at Ludhiana (lat. 30° 56′ N, long. 75° 52′ E). These animals were sexed, weighed and lodged individually in cages and acclimatized for 10 days prior to poison feeding trials. Equal numbers of healthy males and females were used for each trial. The poison baits containing

Table 1. *Efficacy of flocoumafen against* Rattus rattus *and* Bandicota bengalensis

Species	Concentration	Body weight (g) (mean ± S.E.)	Mean bait consumption g per 100 g weight		Mean intake of active ingredient (mg/kg)		Mortality	Days to death mean (range)
			Plain*	Poison	Dead	Survivors		
			No choice test (one day)					
Rattus rattus	0·0005	118·2 ± 8·04	5·48 ± 1·05	6·31 ± 0·51$^{n.s.}$	0·31 ± 0·04	0·32 ± 0·04$^{n.s.}$	4/10	9·8 (5–19)
	0·0025	95·6 ± 8·58	6·27 ± 0·60	5·12 ± 0·73$^{n.s.}$	1·39 ± 0·27	1·12 ± 0·22$^{n.s.}$	6/10	7·3 (4–13)
	0·00375	80·1 ± 10·26	10·62 ± 0·97	7·55 ± 1·03†	2·83 ± 0·39	—	10/10	8·8 (4–15)
	0·005	145·9 ± 5·63	6·11 ± 0·56	5·69 ± 0·61$^{n.s.}$	2·84 ± 0·30	—	9/9	7·2 (4–14)
Bandicota bengalensis	0·0005	120·0 ± 5·47	8·02 ± 0·57	8·92 ± 0·47$^{n.s.}$	0·51 ± 0·02	0·40 ± 0·02†	4/10	9·5 (7–12)
	0·00125	172·5 ± 20·36	7·94 ± 1·64	8·23 ± 1·42$^{n.s.}$	1·03 ± 0·18	—	6/6	9·8 (4–19)
	0·0025	114·2 ± 8·08	5·84 ± 0·66	7·13 ± 0·88$^{n.s.}$	1·78 ± 0·22	—	9/9	7·6 (5–14)
			Choice test (two days)					
R. rattus	0·0025	79·1 ± 9·62	6·47 ± 1·85	14·87 ± 1·61†	3·57 ± 0·53	4·15 ± 0·38$^{n.s.}$	6/8	6·7 (4–9)
B. bengalensis	0·0025	122·7 ± 6·68	2·76 ± 0·93	10·14 ± 1·13†	2·54 ± 0·28	—	8/8	11·5 (8–19)

n.s. Non-significant differences between the values under the columns.

* Consumption of plain food during pretreatment period in non-choice trials and of alternative food in choice trials.

† Significant differences ($P < 0·05$ *t* test) between plain and poison bait consumption and mg/kg intake of poison by dead rodents and survivors.

Table 2. *Survival times of rodents and 95 % confidence limits*

Species	Dose (%)	LT_{16}*	LT_{84}*	LT_{50}	Slope/ function(s)
Rattus rattus	0·005	4·2	8·4	6·3 (5·04–7·88)	1·42 (1·20–1·68)
Bandicota bengalensis	0·0025	4·1	8·4	6·2 (4·92–7·81)	1·43 (1·21–1·69)

Figures in parentheses indicate 95 % confidence limits.

* Survival times of rodents in no-choice tests in which complete mortality occurred, expressed as the number of days to reach a particular mortality percentile.

different concentrations of flocoumafen (Table 1) were prepared from its 0·5 % master mix by using a mixture of wheat flour, sugar and arachis oil (96:2:2). The amount of poison added was adjusted with that of wheat flour. The feeding of poison baits to the rodents in no-choice and choice tests for 1 and 2 days respectively was done as described previously (Chopra & Parshad, 1985). Records of food consumption of pre- and post-treatment periods, symptoms of poisoning and time to death were maintained.

To test the significance of the differences between mean plain and poison food consumption, student's *t* test has been applied (Sokal & Rohlf, 1973). The median survival period (LT_{50}) and 95 % confidence limits of the poison-treated rats were calculated after Litchfield (1949).

The summarized results of the response of rodents to the poison baits are given in Table 1. The Indian mole rat, *B. bengalensis*, was found more susceptible to flocoumafen than the house rat, *R. rattus*, in no-choice trials as they showed 100 % mortality with baits containing 0·00125 % and 0·00375 % poison respectively. Species specific differences have also been reported in the toxicity of coumatetralyl (Chopra & Parshad, 1985) and difenacoum (Lund, 1981). In choice tests also, 100 % mortality occurred with 0·0025 % bait with *B. bengalensis* whereas two of eight animals survived in the case of *R. rattus* (Table 1). However, the median period of survival times (LT_{50}), calculated at 100 % mortality dose levels of the poison for both the species, were similar (Table 2).

At low dose level (0·0005 %) the survivors of *R. rattus* ingested almost equivalent amounts of the active ingredient of the poison to that of the dead rodents. However, the survivors of *B. bengalensis* on 0·0005 % bait consumed significantly less ($P < 0·05$) of the poison than the dead animals.

Six survivors each of *R. rattus* and *B. bengalensis* after their sublethal poisoning with 0·0005 % flocoumafen for 1 day were offered 0·0025 % poison bait after 27–35 days of initial poisoning. The results (not shown) indicated that the sublethal poisoning with flocoumafen had no effect on poison bait consumption and 100 % mortality was achieved with the higher dose.

The poison baits prepared using 0·5 % master mix of flocoumafen were palatable to the rats as differences in the amounts of plain and poison baits were non-significant in no-choice tests except in one case (Table 1) and the poison bait was eaten significantly more ($P < 0·01$) in choice trials.

The potential of flocoumafen for the control of field rodents is suggested as similar to other second-generation anticoagulant rodenticides (Dubock, 1980; Lund, 1981; Parshad, Ahmad & Chopra, 1985). It is effective at low doses, has no effect on bait acceptance and requires 1–2 days of feeding to give 100% mortality.

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