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Research Article

Comparative Efficacy of Bromadiolone, Cholecalciferol and Zinc Phosphide Against Short –Tailed Mole Rat *Nesokia indica* in Captivity

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Abstract: We conducted no-choice and paired choice feeding trials with individually caged *Nesokia indica* to evaluate the efficacy of Bromadiolone, Cholecalciferol and Zinc phosphide baits. Under no-choice test (1 day and 3 day) male rats consumed less bromadiolone bait. However, sex-wise difference was observed non-significant. Under choice feeding test, difference between bromadiolone bait intake and sex was observed non-significant. Under cholecalciferol bait, treated bait was consumed more than plain bait. Among the baits tested, cholecalciferol appeared promising for controlling short-tailed mole rat, *Nesokia indica.*

Key Words: *Nesokia indica,* efficacy, bromadiolone, cholecalciferol, zinc phosphide.

Kısa Kuyruklu Hint Sıçanı, *Nesokia indica*'ya Karşı Bromadiolone, Cholecaliferol ve Çinko Fosfit'in Birbirleriyle Etkileri

Özet: Bromadiolone, Cholecalciferol ve Çinko fosfit katılan yemlerin etkilerini denetlemek üzere, ayrı ayrı kafeslere kapanmış *Nesokia indica*'lar kullanarak seçimsiz ve az seçimli deneyler yaptık. Seçimsiz deney altında (1 ve 3 günlük) erkek sıçanlar daha az bromadioloneli yem tükettiler. Ancak, cinsiyet farkının anlamlı olmadığı gözlenmiştir. Az seçimli deney altında da, bromadioloneli yem tüketimi ile cinsiyet arasındaki bağıntının anlamlı olmadığı bulunmuştur. Cholecalciferollü yem sade yemden daha çok tüketilmiştir. Kısa kuyruklu Hint sıçanı, *Nesokia indica*'yı kontrol etmek için, denetlenen yemler arasında cholecalciferollü yemin en elverişlisi olduğu sonucuna varılmıştır.

Introduction

The rodents are major pests contributing to low agricultural production throughout South East Asia. Among rodents community, short-tailed mole rat, *Nesokia indica* is a pest of primary importance and is widely distributed in Pakistan, India, Iran, Iraq, Egypt, Syria, northern Arabia, Chinese Turkestan and Southern Russian Turkestan (1).

In Pakistan, it inflicts heavy damage to wheat, rice and sugarcane crops (2,3,4). It also causes considerable losses to irrigation water through burrowing in the banks of canals and water courses.

The chemical control is the method mainly used worldwide for controlling rodent depredation. In Pakistan, Zinc phosphide - an acute toxicant and Racumin –a multiple dose anticoagulant are registered rodenticides for urban and agricultural rodent pests. Unfortunately, the efficacy of zinc phosphide is variable and control is often less than complete. Racumin has to be replenished for at least six to seven days which results in the wastage of time, material and labour.

The development of resistance to the first generation anticoagulant stimulated to improve rodenticide. The new second generation anticoagulants a.g., bromadiolone have received considerable research attention for field rodents and look highly promising. They are more toxic to rodents, requiring fewer feedings than any of the previous anticoagulants. Only a single feeding wiil produce death, although death is still delayed. The second generation anticoagulants are presently being used for field rodents control in many parts of the world with phenomenal success (5).

Cholecalciferol (Vitamin D3) has shown potential as

Name of Rodenticide and Concentration	No.of rats (M/F)	Mean body weight (gm—SE)	Feeding dose (gm)	Mean bait intake (gm±SE)	Mean a.i consumed mg/kg body wt.±SE	No.died/ no tested	Days to death	
							Mean±SE	range
1. Bromadiolone (0.005%)	10 M+F	275.8±31.13		10.73±2.18	2.18±0.39	10/10	12.6±2.35	(6-20)
	5 M	325.3±24.25	20	9.84±2.99	1.64±0.53	5/5	13.8±1.99	(9-20)
	5 F	226.4±19.07	20	11.62±1.16	2.73±0.49	5/5	11.4±2.74	(6-20)
2. Cholecalciferol (0.075%)	10 M+F	265.0±22.24		6.41±1.06	17.53±2.48	10/10	10.62±2.03	(5-15)
	5 M	308.0±28.00	15	8.22±0.77	20.05±0.80	5/5	9.50±3.52	(5-15)
	5 F	222.0±17.10	15	4.60±1.58	14.99±4.89	5/5	11.75±2.40	(8-15)
3. Zinc phosphide (2%)	10 M+F	147.4±10.45		1.33±0.15	190.01±29.70	6/10	1	
	5 M	152.0±20.26	20	1.18±0.12	163.71±25.84	4/5	1	
	5 F	142.8±8.70	20	1.48±0.27	216.33±52.96	2/5	1	

Table 1. Mean consumption of Bromadiolone, Cholecalciferol and Zinc phosphide baits and mortality of short-tailed mole rat, *(Nesokia indica)* under 1-day no-choice feeding trials.

1. Contrac Bait
2. Rampage Bait
3. Zinc phosphide Bait

a rodentcicide for controlling rock squirrel *(Spermophilus variegatus)* (6) and rats *(Rattus norvegicus* and *R. rattus)* (7 & 8).

In this document, we describe first hand information on laboratory efficacy of bromadiolone, cholecalciferol and Zinc phosphide for controlling short-tailed mole rat, *(N. indica)* that is a major agricultural pest.

Material and Methods

Test animals

The rats under trial were dug out from rice and sugarcane fields in the suburbs of Thatta Disctrict, Lower Sindh (24°45' N - 67°57' E). They were sexed, weighed and individually caged in the laboratory for three weeks to acclimatize them before undertaking various tests. Pregnant, lactating females and subadults were discarded. The animal rooms had an ambient temperature of 25°C and a light/dark cycle of 12h/12h. The rats were fed on laboratory diet prior to and between various tests. Water was provived *ad libitum.*

Feeding Tests

The experiments were arranged as no-choice and free choice tests. To run these tests, 10 rats (5 of the either sex) were caged singly. Under no-choice test, rats were offered an assigned bait in place of their maintenance diet for one day and three day feeding. We offered 15-20 g fresh bait daily and collected uneaten and spilled bait after 24h interval and weighed to calculate mean daily consumption. Under free choice test, relative intake of assigned bait versus laboratory diet was calculated, the position of the feeding cups was changed daily to avoid place preference trend. Water was available *ad libitum*.

At the conclusion of each feeding trial, we removed the bait from feeding cups and returned to the maintenance diet. During the post-treatment period, we checked the animals daily for mortality or sign of toxicosis. Dead animals were examined for internal bleeding.

The commercial baits under trials were: - i)Rampage-a cholecalciferol-treated bait supplied by Motomco Ltd. Clearwater, Florida USA - a commercial pelleted rodenticide containing 0.075% cholecalciferol ii) Contrac-a Bromadiolone-treated bait supplied by Bell Labs. Inc. Madison WI, USA. iii) ZP bait-a Zinc phosphide bait also supplied by Bell Lab. Inc, Madison WI, USA.

Results and Discussion

No-choice test

In case of 1-day no choice feeding tests (Table 1) overall mean daily intake of both sexes of bromadiolone mixed bait (Contrac) was 10.73±2.18 gm (male 9.84±2.99 gm, female 11.62±1.16 gm). Male rat consumed less poison bait than that of female, the difference in bait intake between sexes being non-significant (P>0.005 by t-test). Thus milligram bromadiolone ingested per kilogram of body weight in male was less than female rats. Overall mean days to death were 12.6±2.35 days (range 6-20). Mean mortality rate was somewhat higher in female than male. This was due to more active ingredients ingested by females than males. The results of the present study are also supported by Marsh (9) in laboratory trials on black rat *Rattus rattus*, where average consumption/rat of plain diet was more than treated diet.

In case of cholecalciferol mixed bait (Rampage bait) male rat consumed more bait (8.22±0.77 gm.), than female rat (4.60±1.58 gm.), therefore milligram/kg body weight ingested were more in male than female. However, the difference remained non-significant

Name of Rodenticide and Concentration	No.of rats sex	Mean body weight (gm±SE)	Feeding dose (gm)	Mean bait intake (gm±SE)	Mean a.i consumed mg/kg body wt.±SE	No.died/ no tested	Days to death	
							Mean±SE	range
1. Bromadiolone (0.005%)	10 M+F	212.49±16.25	20 gms	17.27±0.71	4.19±0.24	10/10	6.6±1.02	(3-11)
	5 M	211.88±28.37	20 gms	17.16±1.08	5.06±0.30	5/5	6.0±1.41	(3-11)
	5 F	213.10±29.27	20 gms	17.40±1.06	4.33±0.39	5/5	7.2±1.56	(3-11)
2. Cholecalciferol (0.075%)	10 M+F	162.53±13.90	20 gms	5.29±0.42	21.49±1.89	10/10	3.8±0.61	(2-9)
	5 M	162.14±12.35	20 gms	5.87±0.69	20.37±2.66	5/5	4.8±1.07	(3-9)
	5 F	202.92±22.61	20 gms	4.72±0.38	22.62±2.92	5/5	2.8±2.30	(2-3)

Table 2. Mean consumption of Bromadiolone and Cholecalciferol baits and mortality of short-tailed mole rat *(Nesokia indica)* under 3-day no-choice feeding trials.

1. Contrac Bait
2. Rampage Bait

Name of Rodenticide	No.of rats and sex	Mean body weight (gm)	Bait intake (gmI±SE)		Mean a.i. ingested mg/kg body wt.	No.died/ no. tested	Days to death	
			Plain	Poison			Mean±SE	range
1. Bromadiolone (0.005%)	10 M+F	198.65±11.73	14.99±0.67	15.57±1.11	3.53±0.37	10/10	10.2±2.01	(4-20)
	5 M	191.92±5.43	14.78±0.78	12.79±3.66	3.35±0.46	5/5	6.6±1.94	(4-14)
	5 F	205.38±23.71	15.19±1.19	14.35±1.59	3.71±0.64	5/5	13.8±2.80	(7-20)
2. Cholecalciferol (0.075%)	10 M+F	174.26±11.11	13.93±0.27	18.18±0.30	81.46±5.92	10/10	8.7±1.74	(1-12)
	5 M	192.5±16.89	14.68±1.19	17.97±0.25	72.49±7.22	5/5	11.0±0.37	(2-12)
	5 F	156.02±9.35	17.17±0.44	18.39±0.56	90.43±8.12	5/5	6.4±2.02	(1-12)

Table 3. Mean consumption of Bromadiolone and Cholecalciferol baits and mortality of short-tailed mole rat *(Nesokia indica)* under 3-day no-choice feeding trials.

1. Contrac Bait
2. Rampage Bait

(P>0.005 by t-test). Male rats died earlier than female rats.

In case of zinc phosphide bait, being acute rodenticide, 6 out of 10 rats died within one day of feeding. The survivors were mainly non-eater of bait, may be due to bait shyness (10). Non-significant difference in bait consumption was noted between sexes (P>0.005 by t-test).

Under 3-day no-choice test (Table 2), combined mean daily consumption of both sexes for bromadiolone bait was 17.27±0.71 gm (male 17.16±1.08 gm; female 17.40±1.06 gm). The difference between sex wise consumption was noted non-significant (P>0.005 by t-test). Likewise milligram active ingredient consumed/kg body weight did not differ significantly. Overall days to death was 6.6±1.02 (male 6.0±1.41; female 7.2±1.56).

In case of cholecalciferol, mean daily intake was 5.29±0.42 gm. Like 1-day no-choice test male rats consumed relatively more bait than female rats, but difference was recorded non-significant (P>0.005 by t-test). Overall mean active ingredient consumed/kg body weight was 21.49±1.89 (male 20.37±2.66; female 22.62±2.92). Mean days to death were 3.8±0.61 (range 2-9).

According to McCann (11) under 3 day no-choice laboratory efficacy study with cholecalciferol on valley pocket gopher *(Thomomys bottae)* bait consumption was 4.08 gm for 0.075% with average mg/kg remained 19.55. These values are closely related with our 3-days no-choice test. In a laboratory study by Tobin *et al.* (12) mean consumption of cholecalciferol bait for northern pocket gopher *(T. talpoides)* was 1.4±0.4 gm while mean mg/kg body weight was 12.2 gm in 0.075% concentration of cholecalciferol in Quintox Rat and Mouse bait.

ii) Choice test

Under free choice feeding test, overall mean daily consumption of bromadiolone mixed bait (Contrac bait) was 15.57±1.11 gm. (Table 3). Non-significant difference was observed between treated vs plain and between sexes (P>0.005 by t-test). Mean days to death differed greatly between male and female. Female rats were observed more tolerant than males.

In case of cholecalciferol mixed bait (Rampage bait), overall consumption between treated vs plain bait was recorded significant (P<0.005 by t-test). Non-significant difference in consumption was recorded between male and female rats. Overall days to death were 8.7±1.74 (range 1-12 days). The results of free choice study clearly showed more intake of cholecalciferol bait in comparison to plain diet. The choice study is of great importance as such trials have not been conducted either by Tobin *et al.* (12) or McCann (11).

Conclusion

Three commercial baits namely ZP bait (Zinc phos-

phide bait), Contrac bait (containing bromadiolone) and Rampage bait (containing cholecalciferol) were evaluated under no choice (in 1 day and 3 day) and paired choice test against short-tailed mole rat, *Nesokia indica*. In ZP bait 60% mortality was noted. The survivors were mainly non-eater of bait, may be due to bait shyness. In case of bromadiolone and cholecalciferol bait, cholecalciferol mixed bait appears promising for controlling short-tailed mole rat, *N. indica*. The results were confirmed by paired choice test, in which treated bait was significantly consumed more than plain bait. Additional laboratory tests are needed to identify the minimum concentration that can successfully control *N. indica*. Field studies should be conducted to evaluate cholecalciferol bait for controlling different field rodent species including mole rats.

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