

## PERFORMANCE OF CALCIFEROL RODENTICIDE AGAINST SOME RODENT SPECIES

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### Abstract

The present study aimed to illustrate the efficacy of calciferol rodenticide against albino rat *Rattus norvegicus* under laboratory and Nile rate *Arvicantis niloticus* under field conditions. Calciferol was more accepted by rats when baited on either crushed maize or whole wheat grains causing higher mortality percentage than on whole sorghum grains under laboratory conditions. Treacle enhanced the rat acceptance to the toxic baits without effect on mortality percentage. Mortality obviously increased with increasing calciferol level and prolongation of exposure period. On the contrary, rat acceptance to calciferol bait was adversely affected with its high level. As for field conditions, the results obtained confirmed those from laboratory trials.

### INTRODUCTION

At the beginning of 1980, Egypt faced a large rodent problem in agricultural area, changes in cultivation pattern and neglecting the control for long time could have intensified this problem which caused considerable reduction in the agricultural products and adversely affected the national income. There is little doubt that the introduction of anticoagulant rodenticides in the early 1950's was a major advance in rodent control and they were the most widely used rodenticides. Several studies were carried out for many years but there were occasions where the use of anticoagulants is not possible. There were some indications that resistance to anticoagulants in rodent species may be correlated with susceptibility to calciferol. Gabr (1997) found that when 0.025% warfarin bait was used, only 60% of animals were killed consuming 192 a.i. mg/kg body weight (b.wt.) and needed 7.8 days for death, but when 0.05% calciferol rodenticide mixed with 0.025% warfarin, the toxic effect of warfarin was enhanced to cause 100% mortality consuming 132 a.i. mg/kg b.wt. and needed 5.8 days for death. The same results were noticed by Kandil et al. (1991). Dickenson (1963), Arafa et al. (1975), Row et al. (1974 and 1978) and Muktha and Mandyam (1978) found that toxicity tests with calciferol combined with

warfarin or any anticoagulant indicated an additive effect between the compounds. Rennison (1974) found that calciferol at 0.1% was an effective poison against *Rattus norvegicus* in field trials. The efficacy of warfarin alone or with additives was tested by Muktha (1979) when warfarin was combined with L-histidine caused 100% mortality against roof rat *Rattus rattus*.

## MATERIALS AND METHODS

Master mix of (3.75% a.i. calciferol [vitamin D2] [9,10 secocholesta 5,7, 10 (19) - trien - 3B - ol] used as rodenticide was obtained from KZ Company, Egypt.

### The efficacy of calciferol rodenticide against some rodent species

#### 1. Under laboratory conditions

Males of white albino rat (*Rattus norvegicus*) weighed 120-200g were obtained from the Egyptian Organization for Biological and Vaccine Production. Animals were housed individually in wire cages and fed on standard diet. The animals were kept under the normal laboratory conditions for at least 3 weeks before the experiments to avoid weakness and sick individuals. All animal were starved for 12 hours before treatment and allowed free excess of water.

#### 1.1 Efficacy of different calciferol baits

The rodenticidal effect of calciferol compound was tested against albino rat when carried on three different baits, i.e., wheat, sorghum and crushed maize materials. Each bait was used with three concentrations (0.0375, 0.050 and 0.075%). Each concentration of the different baits were prepared by adding the amount of master mix of calciferol required to obtain the different concentrations. The poisoned baits and the standard challenge diet (65% crushed maize, 25% ground wheat, 5% sugar and 5% corn oil) were offered to rats in separated small clay containers while free water was accessible. The position of the two containers was reversed daily to avoid preference for a certain location. Consumption of both poisoned bait and challenge diet was estimated daily for four successive days, then the poisoned bait was removed and the survived animals were observed for 17 additional days on standard laboratory diet. Days to death, mortality percentage and bait acceptance were recorded during the whole period of experiment. Bait acceptance was calculated as follows:

$$\text{Acceptance percent} = \frac{\text{Consumed poisoned bait (g)}}{\text{Consumed poisoned bait (g) + standard bait (g)}} \times 100$$

### 1.2. Enhanced toxic bait acceptance

Effect of some additives (sunflower, molasses and tricle) was estimated to enhance the efficacy and acceptance of 0.05% calciferol compound, carried on crushed maize bait, against albino rat (*Rattus norvegicus*). Each additive was used at 5% level. Days to death, mortality percentage and bait acceptance were estimated by the same method mentioned before.

### 1.3 Rodenticidal effect of calciferol bait applied at different exposure periods

The efficacy of 0.05% calciferol compound carried on crushed maize was investigated against albino rat when applied at different exposure periods, i.e. 1, 2,3, and 4 days. Forty acclimatized rats were divided into four groups, each for one exposure period. No-choice feeding test was followed, whereas 10 animals were singly caged and fed on calciferol bait for each exposure period, then standard diet replaced the toxic bait. Survived animals of each treatment were observed until the end of the experiment (21 days). Days to death and mortality percentage were estimated for each exposure period.

## 2. Under field conditions

Calciferol compound carried on wheat, sorghum and crushed maize, each at 0.05% level was evaluated under field conditions of Menofia Governorate. After winter crop harvesting, an infested area with the Nile rat (*Arvicanthis niloticus*) was chosen and divided into four plots (each of two feddans) and separated 100 meter from each other. Three plots were located for the three difference calciferol baits, while the fourth one was left without treatment as a check control. Each treatment was replicated three times, the poupopulation density of rats was estimated before and after treatment in treated and untreated plots by using crushed maize consumption, twenty bait stations were distributed at the infected spots of each plot. In each bait station 250 g of poisoned bait were exposed to rats and the consumed poisoned bait was replenished every three days until the consumption was stopped (El-Deeb, 1985). The required amount of each calciferol bait per feddan and whole period needed for control were calculated, the reduction in rat population was estimated from the following equation:

$$\text{Population reduction} = \frac{\text{Pre-treatment census} - \text{post treatment census}}{\text{Pre-treatment census}} \times 100$$

## RESULTS AND DISCUSSION

### 1. Under laboratory conditions

#### 1.1. Effect of different baits and additives on calciferol potential

Data in Table 1 revealed that crushed maize grains and whole wheat grains proved to be the most accepted ones when used with calciferol compound, while the whole sorghum grains showed the lower acceptance. Percent acceptance of these materials to rats were 36.8, 35.6 and 22.5, respectively with corresponding mortality of 40.0, 40.0 and 20.0 Days required for death reached the minimum with crushed maize (4.5 days) followed by whole wheat (5.5 days) and whole sorghum (6.0 days). Table 2 showed that adding treacle enhanced the rat acceptance to the toxic baits without effect on mortality percentage or time required for death. The present results are in complete harmony with data obtained by Calhoun (1941), Arafa *et al.* (1975), Shaoba (1976) and Kandil *et al.* (1991).

Table 1. Efficacy of calciferol rodenticide at 0.05% on different baits on albino rat *Rattus norvegicus*.

Bait	Palatability %	Days to death	Mortality %
Whole sorghum grains	22.5	6.00	20
Crushed maize grains	36.8	4.50	40
Whole wheat grains	35.6	5.50	40

Table 2. Effect of some additives on the efficacy of 0.05% calciferol rodenticide carried on crushed maize against *Rattus norvegicus*.

Additives	Palatability %	Days to death	Mortality %
Sunflower	35.5	5.0	40
Molasses	35.0	4.5	40
treacle	49.5	5.0	40
Plain crushed maize	36.8	4.5	40

#### 1.2. Effect of different calciferol concentrations

Data in Table 3 revealed that 0.0375% calciferol on whole wheat grains was found to be more palatable (48.1%) and increasing calciferol concentration was associated with a marked decrease in bait acceptance to reach 25.6% at the highest

concentration (0.0750%). Also, it was cleared that concentration of calciferol had evident effect on mortality, whereas 0.0375% level of calciferol failed to achieve any rat killing and mortality percentage increased gradually with increasing of calciferol concentration to reach 60% at 0.075% level. The same trend was observed when calciferol was carried out on crushed maize, bait acceptance was drastically affected with 0.0375, 0.05 and 0.075% calciferol levels, respectively. At the same time 20, 40 and 60% mortalities were achieved with the three tested levels. Acceptance and mortality profile of calciferol carried on whole sorghum grains took the same trend as considerable differences in bait acceptance between the high and low concentrations, i.e. 0.0375%, 0.05% and 0.75% levels caused 22.8, 22.5 and 17.1% acceptance. On the other hand, mortality percentage increased with increasing toxic level to the reach maximum (60%) with 0.075% calciferol. These results are in agreement with Gabr (1991 & 1997) and El-Deeb et al. (1992).

Table 3. Effect of different baits on the acceptance and efficacy of calciferol compound for *Rattus norvegicus*.

Conc.	Wheat bait			Crushed maize bait			sorghum bait		
	Palata- bility	Days to death	Mortali- ty %	Palata- bility	Days to death	Mortali- ty %	Palata- bility	Days to death	Mortali- ty %
0.0375	48.1	0.0	0.0	46.1	5.0	20.0	22.8	6.0	20.0
0.0500	36.7	4.0	40.0	35.6	4.0	40.0	22.5	6.0	20.0
0.0750	25.6	2.0	60.0	13.2	1.5	60.0	17.1	9.0	60.0

### 1.3. Effect of different exposure periods

This trial aimed to discriminate if calciferol compound can be used as a single or multi-dose. The obtained results in Table 4 revealed that 40, 40, 60 and 60% mortalities were obtained when calciferol bait offered to rats for 1, 2, 3 and 4 days, respectively with corresponding times required for mortality were 15, 7, 4 and 3.3 days. It is cleared that consumed calciferol bait by rats drastically decreased after the second day to reach the minimum during the 4th day (0.14 g/rat). This means that rats refused to feed on calciferol baits with the prolongation of exposure period. On the other hand, days required to death prolonged when rats fed on it for short time, i.e. animals killed after 15 and 7 days when fed on calciferol bait for one and two days, respectively, while extension of exposure period shortened death time, i.e. feeding on toxic bait for 3 and 4 days caused rat mortality within 4 and 3.3 days, respectively. In the same time, it is evident that dose of calciferol compound has less potential on mortality than long of exposure period for toxic bait,

whereas 32.84 and 31.07 mg a.i./kg b.wt. taken at one and two days achieved 40% mortality, while 60% was obtained only 19.57 mg a.i./kg b.wt. when exposure period prolonged to 4 days.

These results are in agreement with Rentokil (1959), Hadler (1975), Palmat-  
eer and McCann (1976), Hayes and Gaines (1950).

Table 4. Efficacy of calciferol rodenticide carried on crushed maize bait at concentration 0.05% on different periods on albino rat *Rattus norvegicus*.

Exposure period	Consumed poison bait (g)					a.i/kg b.wt.	days to death	Mortality %
	1st day	2nd day	3rd day	4th day	Mean			
1	6.70				6.7	32.84	15.0	40
2	7.20	5.60			6.4	31.07	7.0	40
3	8.70	6.90	3.40		6.3	28.64	4.0	60
4	10.10	9.10	2.40	0.14	5.4	19.57	3.3	60

## 2. Under field conditions

The efficacy of 0.05% calciferol rodenticide carried on different baits was studied against the Nile rat *A. niloticus* under field conditions.

Data in Table 5 revealed that 0.05% calciferol on crushed maize achieved the highest rat population reduction (91.4%) followed by that on whole wheat grains (78.2%), while when it was carried on whole sorghum grains, its efficacy reached the lowest (75.6%). The amount of calciferol bait required for mortality fairly differed according to the type of bait as their values were 1104, 1083 and 1125 g/ feddan from toxic baits of sorghum, crushed maize and wheat, respectively.

Table 5. Efficacy of 0.05% calciferol rodenticide against Nile rat (*Arvicanthis niloticus*) under field conditions of Menofia Governorate.

Bait	Pre-treatment consumption (g)	Rodenticide consumption (g)	Post-treatment consumption (g)	Population reduction %
Sorghum grains	813	1104	198	75.6
Crushed maize	1275	1083	109	91.4
Whole wheat grains	907	1125	197	78.2

Row et al. (1974) carried out field experiments to determine the efficacy of calciferol combined with warfarin against wild house mice *Mus musculus*. They found that calciferol at 0.1% plus warfarin at 0.25% was an effective combination against house mice. Rennison (1974) investigated the effectiveness of calciferol against *Rattus norvegicus* in field trials on 23 farms with rat infestation partly resistant to warfarin, he found that calciferol at 0.1% was an effective poison against *Rattus norvegicus*.

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## كفاءة مبيد الكالسيفيرول ضد الأنواع المختلفة من القوارض

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تهدف الدراسة التي اجريت على الفأر الالبينو تحت الظروف المعملية وعلى فأر النيل تحت الظروف الحقلية الى معرفه كفاءة مبيد الكالسيفيرول عليهما حيث كانت النتائج كالاتى :

### ١- تمت الظروف المعملية :

اجريت عدة تجارب لمعرفة تأثير الطعوم المختلفة المحمل عليها المبيد (جريش الذره - حبوب القمح الكامله - حبوب الذره العويجه) وتأثير التركيبات المختلفة للمبيد (٠.٣٧٥ ، ٠.٠٥ ، ٠.٧٥) ، وأيضا تأثير فترة تعرض الفأر للمبيد (يوم - يومان - ثلاث ايام - اربعة ايام). وقد وجد ان المبيد المحمل على جريش الذره أو حبوب القمح الكامله اكثر فاعلية ويحقق نسبة موت أعلى من المحمل على الذرة العويجه. وقد زادت قابلية الفئران على المبيد عند اضافة العسل الأسود دون التأثير على نسبة الموت أو مدة الموت. عند استخدام التركيزات المختلفة لوحظ ان أعلى تركيز (٠.٧٥%) حقق أعلى نسبة موت (٦٠%) بينما فشل التركيز الاقل (٠.٣٧٥%) فى تحقيق نسبة موت مرضية، بينما تزداد فاعلية المبيد مع زيادة مدة التعرض له.

### ٢- تحت الظروف الحقلية :

وجد ان كفاءة مبيد الكالسيفيرول على فأر النيل ترتبط بنوع الطعم المحمل عليه حيث وجد أن المبيد المحمل على جريش الذره حقق أعلى نسبة موت من المبيد المحمل على حبوب القمح فى حين أن المبيد المحمل على الذره العويجه حقق أقل نسبة موت .