

LABORATORY TRIALS ON EFFECT OF CERTAIN CONCENTRATIONS OF ZINC PHOSPHIDE ON THE CLIMB RAT, *Rattus rattus* L.,.

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ABSTRACT: Toxicity studies of zinc phosphide (Zn₃P₂) on the climb rat *R. rattus* L., revealed that the daily average of the poisonous bait consumption by *R. rattus* fluctuated slightly under choice and no-choice feeding tests. The average of zinc phosphide bait consumption by females was more than males for all the used concentrations (0.25%, 0.50%, 0.75%, 1%, 1.25% and 1.50%).

The obtained results proved that there is a positive correlation between the concentration of the zinc phosphide in poisonous bait and the consumed amount of the plain bait. Palatability of the tested individuals of *R. rattus* increased significantly at the lower concentrations 0.25%, 0.50% and 0.75% than at higher concentrations 1%, 1.25% and 1.50%, also palatability of females was more than males. On the other hand, all the used concentrations of zinc phosphide gave entire kill for a-males and females for either choice or no-choice feeding tests except for 1.25% (gave kill 2.5/5 choice and 4.5/5 no-choice) and 1.5% (gave kill 3/5 choice and 4/5 no-choice). The average time of death of the climb rat *R. rattus* under choice test was longer than no-choice test at all tested concentrations. Mean body weight of the males fluctuated drastically when compared to females for each of choice and no-choice feeding tests at the different investigated concentrations of zinc phosphide. Also the variations of mean of rat body weight were higher under choice test conditions than no-choice test for the most tested concentrations.

INTRODUCTION

Until the late 1940s the acute toxicants were the only rodenticides available. They are still widely used today; and many uneducated users prefer them despite their relative low efficacy. Rodents which succumb to acute toxicants do so quickly, within a few hours usually, having consumed only a small amount of bait. Most uneducated users, incorrectly, interpret the sight of dead rodent soon after placing small amounts of bait, with only low labour inputs, as proving cheap and effective control.

The aim of this study was to investigate the effect of certain concentrations of zinc phosphide on the climb rat, *Rattus rattus* L., under the laboratory conditions to reduce the recommended concentration of zinc phosphide (1-2%) to overcome the bait shyness and make the rodent control more economic and successful

MATERIAL and METHOD

The wild roof rat, *Rattus rattus* was collected from Fayoum district, Fayoum governorate. For each experiment 10 rats (5 males and 5 females) were used. The rats were weighted to the nearest gram and sex was determined. Animals were retained in individual cages, 42 x 24 x 17 cm. for a maximum of one week before initiating tests. Abnormally large or small animals and obviously pregnant individuals were omitted from the experiment. Food was removed from the animal cages a minimum of 4 hours before administering the chemical choice and no-choice feeding tests. Experiments were conducted using poisonous baits zinc phosphide and plain baits. In the choice test described by Htun and Brooks (1979) two food cups were provided to individually caged animals. One contained plain wheat and the other was fortified with 0.25, 0.50, 0.75, 1.0, 1.25 and 1.50% zinc phosphide. The position of the cups was changed daily to avoid possible baits of position preference. 30 grams of treated and untreated food were provided daily. Intake of poison and plain bait were recorded and computed to g./kg of body weight of the treated animals, the palatability percentage was calculated according to the following equation:

$$\text{Palatability\%} = \frac{\text{Total weight (g.) of poison bait eaten}}{\text{Total weight (gr) of bait base eaten}} \times 100$$

Water was available to rodents through the experiments. Mortality was observed daily and recorded for two weeks after poisoning. The average of death length (days) was calculated - In the no-choice test, zinc phosphide treated wheat grains was offered at concentration of 0.25, 0.50, 0.75, 1.0, 1.25 and 1.50% by weight respectively. Bait consumption was recorded daily and the weight fluctuation and its percentage for both male and female both was calculated. Ten animals of both sexes were singly caged and fed daily on the bait-base (wheat grains) for few days until the rats started feeding on it, then it was estimated, fresh toxic substance and water were supplied daily until all rats died. Another group of ten rats of both sexes was also caged singly with unpoisoned bait and enough water for a period of 3 weeks till the animals of the other tests died (as control animals). The results concerning the total amount of bait consumed (g./kg body weight) and time of death in the fore mentioned feeding tests were statistically analyzed according to Snedecor (1957)

The weight fluctuation of body weight and its percentage for male and female were calculated.

RESULTS and DISCUSSION

The tabulated results in Tables (1 & 2) showed that the average of the daily bait consumption for the applied concentrations of zinc phosphide bait; 0.25%, 0.50%, 0.75%, 1.0%, 1.25% and 1.50% under both choice and no-choice feeding tests were respectively : (3.8 and 5.13 g.), (3.52 and 3.5 g.), (2.03 and 4.20 g.), (0.52 and 2.53 g.), (0.22 and 1.54 g.) and (2.55 and 1.87 g.). These data illustrate that the daily average of the poisonous bait consumption by the climb rat, *Rattus rattus* L., was fluctuated slightly under

both studied feeding systems. In general, there was a negative correlation between the used concentrations and the consumed quantity of its baits by the experimental rats. Average of the daily consumption of zinc phosphide bait by males of the climb rat ranged from 0.27 g./individual/day (1.25% concentration) to 3.52 g./individual/day (0.50% concentration), but for females, it is ranged from 1.54 g./individual/day (1.25% concentration) to 5.13 g./individual/day (0.25% concentration) for choice feeding test (Table 1). Meanwhile for no-choice test the maximum and minimum amount of the daily bait consumption were 5.47 g./individual/day (0.50% concentration) and 1.60 g./individual/day (0.75% concentration) for male and 6.60 g./individual/day (0.75% concentration) and 2.83 g./individual/day (1% concentration) for female, respectively (Table 2). Majumder et al., (1966) found that the LD50 of zinc phosphide was 38 mg/kg.b.w. of *R. rattus* L, Keshta (1996) found that the average of the poisoned bait weight consumption per day for *M. musculus* body weight increased at low used concentrations (0.5% and 1%) than the highest concentrations (2%) of zinc phosphide.

The obtained data in Table (1) show that the average consumed quantities of plain baits by the experimental individuals of *R. rattus* were 4.51, 2.29, 5.08, 7.13, 10.30 and 13.47 g./individual/day against poisonous bait containing 0.25%, 0.50%, 0.75%, 1.0%, 1.25% and 1.50% zinc phosphide mixed thoroughly with wheat seeds. These findings proved that there was a positive link between the concentration of zinc phosphide in poisonous bait and the consumed amount of the plain bait. So it is better to recommend to apply concentrations lower than 1% under field conditions to increase kill percentage to reduce the cost, as well as to minimize the environmental contaminations and risks from the residues of zinc phosphide. Generally, average of the consumed plain bait by female was lower than male for the most tested concentrations.

The compiled results in Table (1) show palatability of the tested climb rat to zinc phosphide under choice feeding test for the used concentrations. The recorded results proved that palatability of *R. rattus* increased clearly at the lower concentrations 0.25% concentration (163.3%), 0.50% concentration (135.5%), 0.75% concentration (124.3%) than higher ones, 1% concentration (21.2%), 1.25% concentration (11.8%) and 1.50% concentration (3.6%). Therefore, the results revealed that palatability of the female *R. rattus* was more than male

Asran (1993) found that the palatability percentages at 1% zinc phosphide were 45.5%, 39.3%, 38.5% and 31.4% for *Mus musculus*, *Rattus rattus*, *Arvicanthus niloticus* and *Rattus norvegicus*, respectively

The presented data in Tables (1 &2) show that the whole used concentrations of zinc phosphide gave complete kill for both males and females climb rat *R. rattus* L., for either choice or no-choice feeding test except for 1.25% concentration (gave kill 2.5/5 choice and 4.5/5 no-choice) and 1.50% concentration (gave kill 3/5 choice and 4/5 no-choice). At last these results proved that there is a positive correlation between the consumed quantity of zinc phosphide bait and mortality percentage for the investigated rats, especially for the lower concentrations less than 1%

Bradfield and Gill (1984) found that zinc phosphide (5.0%) presented in a choice test for two days against unpoisoned feed gave 100% mortality and appears to be the most suitable for these compounds for the control of *M. auratus* in the field.

Data in Tables (1 &2) demonstrated that average of day to death of *R. rattus* under choice test was longer than no-choice test for all the investigated concentrations For example, average time of death at 1.5% conc. was 3.65 and 3.25 hrs. for choice and no-choice tests, respectively. Approximately, time of death for females was shorter than male for most applied concentrations under both studied feeding systems

Wahab et al (1997) stated that both time to death and mice body reduction have a negative correlation with the tested concentration. There was also a negative link for non-choice test. Similarly, the results proved that there is a negative correlation between the used concentrations and palatability, time to death and mice body weight for choice test

Asran (1994) found that the mean length of time death in choice test was little longer than in no-choice test for the different examined animals. At 1% zinc phosphide bait gave satisfactory mortality for the tested animals under laboratory conditions.

Mean of the climb rat body weight, at choice test (Table 1) fluctuated strongly The highest fluctuation was recorded at 1.25% conc. (9.7 g.) for male and was 6.2 g. at 1.5% conc. Meanwhile, the lowest fluctuations for male and female were respectively 1.7 g. (1.5% conc.) and 1.8 g. (1% conc.). But, at no-choice test the highest peak for *R. rattus* body weight fluctuation was noticed at 0.75% (8.5 g.) and 1.25% (6.0 g.) for males and females; whereas the lowest peak was respectively; 1.7 g. at 1% conc. And 1.3 g. at 1.50% conc.. In general, the mean of body weight of the males of *R. rattus* fluctuated drastically than females for both choice and no-choice feeding tests at the different investigated concentrations of zinc phosphide; 0.25%, 0.50%, 0.75%, 1%, 1.25% and 1.50% under laboratory conditions. The variations of mean of the rat body weight were highest under choice test than no-choice test for the most tested concentrations

Wahab et al. (1997) studied the toxicity of zinc phosphide (Zn_3P_2) on the wild and albino house mouse *M. musculus* L.. They found that the reduction of mice body weight who objected to the choice test increased slightly than under non-choice test conditions.

Table (1) Effect of different concentrations of zinc phosphide on mean of consumption (g) of plain and poisonous baits by the climb rat, *Rattus rattus* L., and their palatability %, mortality %, mean time of death and body weight fluctuations under laboratory conditions .
(Choice feeding test) .

Concentration	Sex	Mean of consumed bait (in g/day/individ.		Palatability %	Mortality %	Mean time of death (hrs)	Mean of tested individual weight (in g)		Fluctuation
		Plain	Poisonous				before	after	
0.25%	male	7.25	3.08	26.5	5/5	16.1	192.7	193.3	2.7
	female	1.76	5.13	300	5/5	6.1	158.3	160.3	-2.0
	mean	4.51	4.11	163.3	5/5	11.9	175.5	176.8	2.4
0.50%	male	1.58	3.52	154.2	5/5	2.4	126.5	126.2	5.0
	female	3.00	3.50	116.7	5/5	5.0	143.0	148.8	-5.8
	mean	2.29	3.51	135.5	5/5	3.7	134.8	137.5	5.4
0.75%	male	8.35	2.03	15.3	5/5	14.3	100.8	102.7	-3.8
	female	1.80	4.20	233.3	5/5	4.3	155.3	157.5	-2.2
	mean	5.08	3.12	124.3	5/5	9.3	128.1	130.1	-3.0
1.00%	male	7.90	0.52	3.2	5/5	13.3	125.3	130.6	-5.3
	female	6.36	2.53	39.1	5/5	13.5	135.3	136.5	-1.8
	mean	7.13	1.53	21.2	5/5	13.4	130.3	133.6	-3.6
1.25%	male	12.64	0.27	1.4	2/5	12.0	151.0	160.7	-9.7
	female	7.96	1.54	5.8	3/5	5.8	149.6	152.0	-5.0
	mean	10.30	0.91	3.6	2.5/5	8.9	150.3	156.4	-7.4
1.50%	male	10.20	2.55	14.5	3/5	3.5	151.6	153.3	-1.7
	female	16.74	1.87	9.1	2/5	3.8	157.0	160.6	-6.2
	mean	13.47	2.21	11.8	2.5/5	3.7	154.3	156.9	-3.9

Table (2) Effect of different concentrations of zinc phosphide on mean of consumption (g) of poisonous baits by the climb rat, *Rattus rattus* L., and their mortality % , mean time of death and body weight fluctuation under laboratory conditions .
(no-choice feeding test) .

Concentration	Sex	Mean of consumed poisonous bait (in g)/day/individ.	Mortality %	Mean time of death (hrs)	Mean of tested individual weight (in g)		Fluctuation
					before	After	
0.25%	male	2.28	5/5	16.3	158.8	156.2	-3.0
	female	4.60	5/5	4.9	128.0	129.6	-1.7
	mean	3.44	5/5	10.6	143.4	142.9	-2.4
0.50%	male	5.47	5/5	4.2	178.0	177.5	6.8
	female	6.20	5/5	4.3	134.6	136.6	-2.0
	mean	5.84	5/5	4.3	156.3	157.1	4.4
0.75%	male	1.60	5/5	4.3	93.5	96.7	-8.5
	female	6.60	5/5	3.4	160.0	162.3	-2.3
	mean	4.10	5/5	3.9	126.8	129.5	-5.4
1.00%	male	2.10	5/5	3.8	77.8	79.5	-1.7
	female	2.83	5/5	4.0	120.7	120.5	2.5
	mean	2.47	5/5	3.9	99.25	100.0	2.1
1.25%	male	3.90	5/5	2.8	125.6	128.8	-2.3
	female	3.10	4/5	3.8	141.3	136.7	6.0
	mean	3.50	4.5/5	3.3	133.5	132.4	4.2
1.50%	male	2.00	5/5	4.0	129.7	129.2	2.8
	female	4.20	3/5	2.5	120.6	122.0	-1.3
	mean	3.10	4/5	3.3	125.2	125.6	2.1

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دراسات معملية على تأثير تركيزات معينة لفوسفيد الزنك: على الفأر المتسلق

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أوضحت دراسات سمية فوسفيد الزنك على الفأر المتسلق أن متوسط الإستهلاك اليومي للطعم السام كان يتذبذب بدرجة بسيطة تحت ظرفى التغذية الإختيارية والإجبارية . هذا وكان متوسط الإستهلاك اليومي للإناث لطعم فوسفيد الزنك أكثر من الذكور بالنسبة لكل التركيزات المختبرة ٠,٢٥٪ ، ٠,٥٠٪ ، ٠,٧٥٪ ، ١٪ ، ١,٢٥٪ ، ١,٥٠٪ . وقد أكدت النتائج المتحصل عليها أن هناك علاقة موجبة بين تركيز فوسفيد الزنك فى الطعم السام وبين الكمية المستهلكة من الطعم غير السام المقابل . أما بالنسبة لمدى قابلية الفأر المتسلق لطعم فوسفيد الزنك فدللت النتائج على أنها تزداد بوضوح فى التركيزات المنخفضة ٠,٢٥٪ ، ٠,٥٠٪ ، ٠,٧٥٪ ، عن التركيزات العالية ١٪ ، ١,٢٥٪ ، ١,٥٠٪ ، بالإضافة الى ذلك كانت قابلية الإناث أعلى من قابلية الذكور . ومن الناحية الأخرى نجد أن كل التركيزات المختبرة من فوسفيد الزنك قد أعطت نسبة موت كاملة لكل من الذكور والإناث تحت ظرفى الإختبارات إختيارية التغذية التغذية فيما عدا تركيز ١,٢٥٪ ، (أعطى موت ٢٠٥ / ٥ إختيارى ، ٤,٥ / ٥ إجبارى) وتركيز ١,٥٠٪ (أعطى ٣ / ٥ إختيارى / ٤ إجبارى) . بينما كان متوسط الوقت اللازم للوفاءه تحت ظروف التغذية الإختيارية أطول من إجبارية التغذية بالنسبة لكل التركيزات المستعملة . وفوق ذلك كان متوسط وزن الجسم لذكور الفأر المتسلق يتذبذب بشدة عن الإناث لكل من أختبارى إختيارى التغذية بالنسبة لجميع التركيزات المختبرة لفوسفيد الزنك ، وبالإضافة لذلك فإن الإختلافات فى متوسط أوزان الفئران الفذران المتسلقة تحت الظروف إختيارية التغذية كان أعلى من إجبارية التغذية لمعظم التركيزات المستعملة .