ENHANCING THE EFFICIENCY OF ZINC PHOSPHIDE BAIT USING ANTISPASMODIC AGENT(OCTYLONIUM BROMIDE) AGAINST ALBINO AND WILD NORWAY RATS

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Abstract

Laboratory and field trials were conducted to enhance the efficiency of zinc phosphide bait against rats using Spasmomen drug (octylonium bromide) as an antispasmodic agent. Spasmomen was tested alone and mixed with zinc phosphide bait at different concentrations using non and free choice feeding methods against albino rat and wild Norway rat, *Rattus norvegicus*. Results indicated that Spasmomen at rate 0.05% when added to zinc phosphide bait at level 0.25 and 0.125% achieved 43.5 and 46.3% acceptance, respectively and enhanced the mortality from 50 to 75%. The field performance was in harmony with laboratory results as Spasmomen enhanced the population reduction percentage of Norway rat from 17.4 to 56.0 % and from 66.0 to 71.2% when added to zinc phosphide bait 0.125 and 0.25%, respectively. The antispasmodic action of Spasmomen prevent the pain resulting from zinc phosphide treatment. This action lead rats to accept the bait of zinc phosphide and eat more causing high mortality percentage.

Key words: Zinc phosphide - Antispasmodic agent – Norway rat.

INTRODUCTION

Zinc phosphide is an important rodenticide, since it is effective against rats and mice, rather cheep, locally produced and is an acute poison with a quick mode of action. It is especially useful for the rapid reduction of large population of rodents. Also, zinc phosphide is probably the acute poison of choice when anticoagulant cannot be used or are not available. Bait shyness is the major drawback in using zinc phosphide against different rodent species (Meehan, 1984). The consumption of a small quantity of zinc phosphide (1/4 LD_{50}) at the first time, is likely to be sufficient to elicit unpleasant symptoms but not to cause death. The fast onset of toxicsis enables rodents then to associate cause and effect. Affected animals will usually refuse to consume the poisoned food on subsequent occasions or may be reluctant to feed again from bait receptacles (Prakash, 1988).

The present study was an attempt to overcome bait shyness phenomenon using antispasmodic agent to prevent the pain resulting from zinc phosphide treatment under laboratory and field conditions.

MATERIALS AND METHODS

1- Tested Compounds

1-1- Zinc phosphide 94% (Zn_3P_2) is an acute rodenticides obtained from KZ Company. It was used as a bait at rate of 0.5, 0.25, 0.125 and 0.0625% mixed with crushed maize.

1-2- Spasmomen drug (octylonium bromide 40 mg), p-[2-(n-octyloxy)-benzoyl]-aminobenzoate of N-diethyl-methyl- ammonium- ethyl bromide. It is an antispasmodic agent in the treatment of spastic states and gastrointestinal tract spasm. It was obtained from Minapharm Co., as tablets each of 40 mg. It was powdered and used at 0.1 and 0.05% mixed with crushed maize or added to zinc phosphide bait.

2- Tested Animals

The adult individuals of albino rat, *Rattus norvegicus* (Berk.) were used for laboratory experiments. Animals were caged individually and fed on a free diet and water. The unhealthy and pregnant animals were excluded. Animals were weighed and given a reference number for each one. The field experiments were conducted on the wild Norway rat, *Rattus norvegicus*, which was the dominant species in drainage canal, El-Wasta district, Beni- Suef Governorate.

3- Laboratory Experiments

Different concentrations of zinc phosphide bait were tested alone and mixed with Spasmomen drug using non and free choice feeding methods.

3-1- Non Choice Feeding Method

3-1-1- Zinc Phosphide Treatment

Four different concentrations of zinc phosphide bait i.e. 0.5, 0.25, 0.125 and 0.0625% were tested against albino rat *Rattus norvegicus*. Animals were divided into 4 groups (each of 8 rats). One group for each tested concentration and another one as a check control. Each animal was offered 20g of zinc phosphide bait for 24h, then replaced by untreated bait. The consumed amount of bait was daily calculated. The clinical symptoms of poisoning on animals were observed. Mortality and time to death were recorded.

3-1-2- Spasmomen Treatment

Two concentrations of Spasmomen was tested alone and added to zinc phosphide bait against albino rat. Animals were divided into 6 groups (each of 8 animals) for treatments and another one for control. The six treatments were: Spasmomen 0.1 and 0.05%, combination of Spasmomen 0.1% + zinc phosphide 0.25%, mixture of Spasmomen 0.1 + zinc ph. 0.125%, Spasmomen 0.05% + zinc ph. 0.125% and Spasmomen 0.05% + zinc ph. 0.125%. Fifty grams of bait were offered to each rat for 4 successive days. The consumed amount of bait was daily estimated

and the clinical symptoms of poisoning were observed. Mortality percentage and time to death were recorded

3-2-Free Choice Feeding Method

Free choice feeding test is important to determine the acceptability of the tested compound (Gabr *et al.*, 2004) by comparing its consumption with that of standard challenge diet (65% crushed maize + 25% ground wheat + 5% sugar + 5% corn oil) according to Palmateer (1974). Animals were divided into 6 groups (8 animals of each). One group for each treatment and another one as a control. One of the tested baits (Spasmomen alone at 0.1 and 0.5%, zinc phosphide alone at 0.25 and 0.125% and mixture of the two compounds) and challenge diet were offered to each animal (50g of each) in small separate dishes. Their position was daily altered to avoid feeding preference for a certain location. The consumed amount of bait and diet was recorded daily for 4 successive days. The same previous proceeding was followed. A check control test was conducted using standard diet. Bait acceptance was recorded as follows:

$$\text{Acceptance } \% = \frac{\text{Consumed amount of treated bait}}{\text{Consumed amount of treated bait} + \text{Callenge diet}} \times 100$$

4- Field Experiments

Evaluation of different concentrations zinc phosphide bait alone and mixed with Spasmomen drug was carried out under field conditions of El- Wasta district, Beni-Suef Governorate. An area infested with Norway rat, *Rattus norvegicus*, was chosen and divided into distances (each of 200m) represents the number of treatments and another one was left without treatment as a check control. The population density of rats was estimated pre and post treatment using food consumption method (Rennison, 1977). Twenty five plastic sacks (each of 20g) for each treatment were distributed in the infested spots beside rat burrows for 48 hrs. The consumed amount of each treatment was recorded and the percentage of population reduction was calculated as follows:

$$\text{Population reduction } \% = \frac{\text{Pre-treatment consumed} - \text{Post-treatment consumed}}{\text{Pre- treatment consumed}} \times 100$$

RESULTS AND DISCUSSION

1- Laboratory Studies

1-1 Non- Choice Feeding Test

The effect of different concentrations of zinc phosphide bait against albino rat was shown in Table (1). Data indicate that the average bait consumption increased with the decrease of the concentration of zinc phosphide as o.5, 0.25, 0.125 and

0.0625% concentration gave 4.1, 4.3, 4.8 and 5.0g, respectively. Both concentrations of 0.5 and 0.25% achieved complete mortality 100%. The concentration of 0.125% caused only 50% mortality while the lowest concentration 0.0625% fail to achieve any mortality percentage. Regarding the time required to death, it longed with reducing zinc phosphide concentration whereas it was 9, 15 and 18h for the three tested concentrations 0.5, 0.25 and 0.125%. consecutively. Data in Table (2) showed the response of albino rat to zinc phosphide bait mixed with Spasmomen drug under non-choice conditions. Results revealed that zinc phosphide bait 0.25% when mixed with Spasmomen 0.1 or 0.05% induced 100% mortality with 6.7 and 7.0g average bait intake, respectively. The time required to death was shorter in case of Spasmomen 0.1% than 0.05% as it was 9h with range 6-12h for the first while it was 10.5h and ranged between 7-12h for the second. Concerning the combination of zinc phosphide 0.125%+ Spasmomen 0.1% or 0.05%, both combinations gave the same mortality percentage 75%. But there was considerable variation in the average time to death where it was 15h and ranged between 12-24h for the first combination and 17h with wide range 6-24h for the second mixture. On the other side, the average bait consumption raised to 10.4g in case of Spasmomen 0.05% comparing with 9.2g for Spasmomen 0.1% when added to 0.125% zinc phosphide bait. From the previous results in Tables (1 and 2) it could be observed that Spasmomen at level 0.05 or 0.1% enhanced the mortality percentage from 50 to 75% when added to zinc phosphide bait at rate 0.125% with increasing the amount of bait intake from 4.8g for zinc phosphide alone to reach 10.4g in case of the same concentration of zinc phosphide mixed with 0.05% Spasmomen. Also, the range of time to death was shorter (6-24h) with mean of 17.0h for zinc phosphide alone than (12-24h) and average 18h for the combination, respectively. Metwally (2005) found that addition of 0.001% Librax drug increased the average consumption of bait treated and untreated with zinc phosphide. Asran (1994) recorded that in free and non- choice feeding tests on *Arvicanthis niloticus*,1.0% zinc phosphide bait gave 80 and 90% mortality.

1-2 Free- Choice Feeding Test

The response of albino rat to Spasmomen alone or mixed with zinc phosphide bait under free- choice conditions was shown in Table (3). Regarding the treatment of Spasmomen alone, data revealed that animals accepted on Spasmomen 0.05% more than the same compound when used at 0.1% whereas the acceptability percentage was 51.6% for the lowest concentration of Spasmomen while it was 48.7% in case of the highest concentration. On the other hand, Spasmomen at rate 0.05% when added to zinc phosphide bait at 0.25 and 0.125% enhanced the acceptance to 43.5 and 46.3% comparing with 6.1 and 10.2% for zinc phosphide alone, respectively. The

palatability increased with decrease of zinc phosphide concentration. Zinc phosphide at 0.125 and 0.25% achieved only 25 and 50% mortality while mixing of 0.05% Spasmomen with the same concentrations of zinc phosphide enhanced the mortality to 50 and 75%, respectively. Mortality percentage increased with increasing zinc phosphide concentration. The opposite occurred with time to death as it reduced from 20h with range 18 - 24h in case of low concentration to 18h and range 12 - 24h for the high concentration of zinc phosphide bait. Metwally (2005) found that the acceptability of roof rat *Rattus rattus* to zinc phosphide bait 1.0% increased with addition of 0.001% librax drug by 4.7% while mortality percentage was 100% for both. El- Deeb *et al* (1991) stated that zinc phosphide bait shyness could be solved with Nile rat *Arvicanthis niloticus* with changing preferred baits and additives.

2- Field Studies

The efficiency of zinc phosphide bait alone at 0.25 and 0.125% and mixed with Spasmomen 0.05% was tested against wild Norway rat, *R. norvegicus* under field conditions. Data in Table (4) show that the combination of zinc phosphide 0.25%+ Spasmomen was the most effective one as it gave 71.2% rat population reduction followed by 66.0% for zinc phosphide 0.25% alone and 56.0% for the mixture of zinc phosphide 0.125%+ Spasmomen while zinc phosphide 0.125% alone came in the last rank as it caused only 17.4% population reduction. On the other hand, mixing of 0.05% Spasmomen enhanced the consumed amount of zinc phosphide bait from 350 to 424g and from 401 to 470g for the two concentrations of zinc phosphide, respectively. Reviewing the aforementioned results, it is obvious that the field performance was in harmony with laboratory results. Meehan (1984) stated that Norway rat is the most wary feeder and affected by neophobia. El- Deeb *et al.* (2007) suggested that the longest bait shyness period to zinc phosphide was recorded with Norway rat between the different rodent species.

Discussing the previous data, it could be concluded that the antispasmodic action of Spasmomen drug prevent the pain resulting from zinc phosphide treatment under laboratory and field conditions. This action lead rats to accept the bait of zinc phosphide and eat more. These result was confirmed during the laboratory studies as no spasmodic effects or pain were observed on the animals treated with Spasmomen when added to zinc phosphide comparing with those treated with zinc phosphide alone. Richard and Pamela (2000) and Sweetman (2002) mentioned that the antispasmodic drugs has effect on the symptomatic treatment of gastrointestinal spam or discomfort of the gastrointestinal tract that may be associated with spam of smooth muscles of the gut.

Table 1. Effect of different concentrations of zinc phosphide bait against albino rat using non choice feeding test.

Concentration of zinc ph. Bait %	Average bait consumption (g)	% Mortality	Time to death (h)	
			Mini – Max.	Mean
0.5	4.1	100	6- 12	9
0.25	4.3	100	12- 24	15
0.125	4.8	50	12- 24	18
0.0625	5.0	0.0	0.0	0.0
L.S.D		27.8		

Table 2. Response of albino rat to zinc phosphide bait mixed with Spasmomen drug using non- choice feeding test.

Treatment	Average bait consumption (g)	% Mortality	Time to death (h)	
			Mini – Max	Mean
Zinc ph. 0.25% + Spasmomen 0.1%	6.7	100	6- 12	9
Zinc ph. 0.125% +Spasmomen 0.1%	9.2	75	12- 24	15
Zinc ph. 0.25%+ Spasmomen 0.05%	7.0	100	7- 12	10.5
Zinc ph. 0.125% +Spasmomen 0.05%	10.4	75	6- 24	17.0
L.S.D.		15.3		

Table 3. Effect of Spasmomen drug on the acceptance of zinc phosphide bait to albino rat using free- choice feeding test.

Treatment	% Acceptance	% Mortality	Time to death (h)	
			Mini – Max	Mean
Spasmomen 0.1%	48.7	0.0	0.0	0.0
Spasmomen 0.05%	51.6	0.0	0.0	0.0
Zinc ph. 0.25%	6.1	50	12 - 24	16.5
Zinc ph. 0.25%+ Spasmomen 0.05%	43.5	75	12 - 24	18
Zinc ph. 0.125%	10.2	25	12 - 24	18.5
Zinc ph. 0.125%+ Spasmomen 0.05%	46.3	50	18 - 24	20
L.S.D.		10.5		

Table 4. Efficacy of zinc phosphide bait mixed with 0.05% Spasmomen drug against Norway rat *Rattus norvegicus* under field conditions.

Treatment	Bait consumption (g)			%Population reduction
	Pre-treatment	Treatment	Post-treatment	
Zinc ph. 0.25%	642	350	218	66.0
Zinc ph. 0.025% + Spasmomen	565	424	163	71.2
Zinc ph. 0.125%	593	401	490	17.4
Zinc ph. 0.125% + Spasmomen	482	470	212	56.0
L.S.D.				5.2

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رفع كفاءة طعم فوسفيد الزنك باستخدام عقار أوكتيلونيوم بروميد كمسكن للألم ضد الجرذ الأبيض والنرويجى

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أجريت بعض التجارب المعملية والحقلية لرفع كفاءة طعم فوسفيد الزنك ضد الفئران باستخدام عقار اسبازمومين (أوكتيلونيوم بروميد) كمضاد لتقلصات وانقباضات القناة الهضمية.

تم اختبار عقار اسبازمومين على حدة ومخلوطا بطعم فوسفيد الزنك بتركيزات مختلفة باستخدام طريقتى التغذية الاختيارية واللااختيارية ضد الجرذ الأبيض فى المعمل والجرذ النرويجى فى الحقل فى مركز الواسطى بمحافظة بنى سويف.

أظهرت النتائج انه عند إضافة عقار اسبازمومين بتركيز ٠,٠٥ % إلى طعم فوسفيد الزنك بتركيز ٠,٢٥، ٠,١٢٥% حقق نسبة استساغة قدرها ٤٣,٥، ٤٦,٣% على التوالى وكذلك رفع نسبة الموت من ٥٠ إلى ٧٥%. وأظهرت النتائج الحقلية توافقا مع النتائج المعملية حيث ارتفعت نسبة الخفض فى تعداد الفئران من ١٧,٤ إلى ٥٦% ومن ٦٦ إلى ٧١,٢% عند إضافة اسبازمومين إلى طعم فوسفيد الزنك بتركيز ٠,١٢٥، ٠,٢٥% على التوالى.

يتضح من النتائج أن تأثير عقار اسبازمومين يمنع الألم الناتج عن المعاملة بفوسفيد الزنك مما أدى إلى قبول الطعم لدى الفئران وشجعها على تناوله بكمية أكثر مما ساعد على زيادة نسبة الموت.