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Evaluation of some rodenticides and traps for controlling the Norway rat, *Rattus norvegicus* Berk., in poultry farms at Giza governorate, Egypt

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Abstract

Different control methods (i.e. Zinc Phosphide 2% and 3%; Super Caid 0.005% and Live traps) against *Rattus norvegicus* Berk., evaluated by food consumption method in poultry farm (Bortos village -El Warraq area) at Giza Governorate during August and September 2016. The highest poison baits daily consumption were recorded when used Super Caid 0.005% (52.53 and 40.39 g/night) followed by Zinc phosphide 2% (0.23 and 1.93 g/night) and Zinc phosphide 3% (0.09 and 0.26 g/night)) inside and outside building. The Super Caid 0.005% treatment gave high mortality numbers against *R. norvegicus* inside and outside the building. The pest mortality records increased from 3rd day until 6th day of treatment. Mortality records during treatment (inside building) were 7, 6, 6, 4 and 2 individuals in 7, 6, 5, 3 and 4 days, respectively. While mortality records during treatment (outside building) were 11 and 8 individuals in 6 and 7 days, respectively. The highest reduction of *R. norvegicus* when used Super Caid 0.005% were 79.98 and 46.04 % followed by Zinc phosphide 2% (51.85 and 36.51 %) and Zinc phosphide 3% (67.6 and 32.15 %)) inside and outside building. While, when used live trap bait items inside building with attractants such as: tomato, lanshon, cucumber and falfel the reduction percentages in rat individuals were 78.41, 61.32, 92.43 and -65.1%, respectively. The analysis of variance and treatment means were significantly different between plain bait daily consumption pre-treatment of all transactions (Super Caid 0.005%, Zinc phosphide 2% and 3% inside and outside building and also live trap bait items).

Keywords: Rodent, food consumption, poultry farm, Zinc Phosphide, super Caid, live traps.

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Introduction

The Norway rat, *Rattus norvegicus* was the major pest species inhabiting poultry farms around Mexico City. The problem has become more serious in the last 10 years with an increase of the pest in urban development around poultry farms (Beatriz Villa et al., 1997). In Giza Governorate, Abdel-Wanees (2008) mentioned that, the Norway rat was the most dominant species (41.7%) followed by the white bellied rat, *Rattus rattus frugivorus* (Rafinesque) (32.36%) followed by the black bellied rat, *Rattus rattus rattus* (Linnaeus) (18%). Whereas the grey-bellied rat, *Rattus rattus alexandrinus* (Geoffray) and the Nile grass rat, *Arvicanthis niloticus* (Desmarest) showed low percentages (3.52 and 3.22%).The *Mus musculus* L. was the lowest one given the presence of 1.2%. On the other side, Desoky (2013) used three mechanical control methods (i.e., manual destruction, deep irrigation and traps) in addition to the use of two rodenticides (Super Caid % 0.004 and Zinc phosphide % 3) in order to study of their efficacy against rodents.. The reduction of rodents when used spring wire traps was 18.96% and 55.06% and 80% when used Super Caid bait and Zinc phoshide. While, Brodifacoum gave 93.3 % reduction, at Fayom Governorate (El-Deeb, 2015). The present work was carried out using different control methods (chemical and mechanical controls) against *R. norvegicus* in poultry farm (Bortos village-El Warraq area) at Giza Governorate, Egypt.

Materials and methods

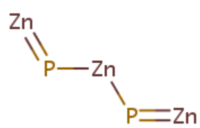
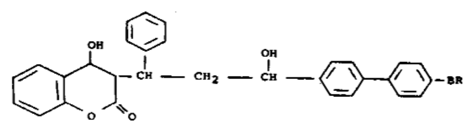
Two types of control methods were used (chemical and mechanical control) in order to study the efficiency of these methods in reducing the census of the Norwegian rat in Bortos village at Giza governorate, Egypt.

Chemical control: In the current study two rodenticides were used, the common name, trade name, group and the chemical structure for both compounds have been revised in Table (1).

Acute poison (Zinc Phosphide ®): The commercially available toxic bait types were used in bait stations to prevent rodent reinvasion to the poultry farm (Bortos village - Al-Warraq area at Giza Governorate). Sixty bait stations inside and outside the poultry farm were distributed at 10 meters distance beside rodents run-ways and active burrows. Zinc phosphide (2% and 3%) baits (food diet) preparations custom-made by manufacturer in this farm. Zinc phosphide baits were provided for 7 days and the treatments were preceded by three days pre and post-baiting with plain crushed maize grains. The poison baits were checked and the refilled day and consumption were determined by weighting back to the nearest gram. On the last day of the pre-baiting period the crushed maize grains were removed and replaced before treatment by one day zinc phosphide bait. The zinc phosphide bait was removed and replaced by plain crushed maize grains during the three days after treatment. The consumption during the last 24 hours of the pre-and the post-baiting periods was used for calculation of relative treatment efficacy according to the method of Pelz and Klemann (2004).

Chronic poison, (Anticoagulant, Super Caid 0.005 %®): The Super Caid baits were prepared and treated with the same technique of the former compound referred to above. .The Super Caid 0.005% bait was prepared by using wheat grains saturated with super Caid. The Super Caid bait was provided for 13 days. Treatments were recorded follow by a three days pre-or post-baiting with plain crushed maize grains. The poison baits were checked and refilled daily and the consumption was determined by weighing back to the nearest gram. On the last day of the pre-baiting period the crushed maize grains were removed and replaced by Super Caid bait. At the last day of the treatment period the Super Caid bait was removed and replaced by plain crushed maize grains.

Table 1: . Rodenticides used to control the Norway rat, *R. norvegicus*.

Rodenticides	1	2
Common name	Zinc phosphate	Bromodialone
Trade name	Zinc phosphide	Super Caid 0.005%
Group	Inorganic chemical	Anticoagulant
Molecular weight	386.11gm/mol	527.41 gm/mol
Molecular formula	$Zn_3(PO4)_2$	$C_{30}H_{23}BrO_4$
Structure		

The consumption during the last 24 hours of the pre-and the post-baiting periods was used for calculation of relative treatment efficacy according to the statistical analysis of Pelz and Klemann (2004).

Mechanical control (Live traps): Wire-box live traps with spring doors were used for three consecutive nights and daily supplied with baits of tomato, lanshon, cucumber and falfel in poultry farm (eggs produce). Traps were distributed at 10 meters distance beside rodent's run-ways and active burrows in poultry farm (Bortos village -El Warraq area) at Giza Governorate, Egypt. Evaluation of control method of *R. norvegicus* by food intake pre- or post-baiting treatment through 1st, 2nd and 3rd days, as mentioned by Bakri and Al-Gendy (2007). Henderson and Tilton (1955) equation was applied to calculate the reduction of the pest numbers.

Statistical analysis: Data were analyzed using analyses of variance (MSTAT-C. 1988) and means were separated using the least significant differences method (L.S.D) at 5% probability level, only when a significant "F" test was obtained (Steel & Torrie, 1984).

Results and Discussion

Data in Table (2) showed that, the highest plain bait daily consumption pre-treatment were recorded when used Super Caid 0.005% (9.89 and 21.22 g/night) followed by Zinc phosphide 2% (0.54 and 5.78 g/night) and Zinc phosphide 3% (0.5 and 0.93 g/night)) inside and outside the building. The highest plain bait daily consumption post-treatment were recorded when used Super Caid 0.005% (1.99 and 11.45 g/night) followed by Zinc phosphide 2% (0.27 and 3.67 g/night) and Zinc phosphide 3% (0.16 and 0.63 g/night)) inside and outside the building . The highest poison bait daily consumption were recorded when used Super Caid 0.005% (52.53 and 40.39 g/night) followed by Zinc phosphide 2% (0.23 and 1.93 g/night) and Zinc phosphide 3% (0.09 and 0.26 g/night)) inside and outside the building .

Table 2: Evaluation of chemical control method against *R. norvegicus* individuals inside and outside the building of poultry farm at Giza governorate, Egypt.

Treatment time	Poisons treatment (mean)	Consumption pre-treatment/grams (3nights)		Consumption treatment/grams		Consumption post-treatment/grams (3nights)		Reduction (%)	
		Inside build	Outside build	Inside build	Outside build	Inside build	Outside build	Inside build	Outside build
One night	Zinc phosphide 2%	0.54	5.78	0.23	1.93	0.27	3.67	51.85	36.51
One night	Zinc phosphide 3%	0.5	0.93	0.09	0.26	0.16	0.63	67.6	32.15
Seven nights	Super Caid 0.005%	9.89	21.22	52.53	40.39	1.99	11.45	79.98	46.04

L.S.D (0.05): 2% Treatment: pre and after inside= 0.64 and pre and after outside= 2.71. Day: inside=0.45; outside=2.71.
L.S.D (0.05): 3% Treatment pre and after inside= 0.72 and pre and after outside= 5.01. Day: inside=0.52; outside=5.01.

Data in Table (3) showed that the effect treatment when used Super Caid against *R. norvegicus* gave high mortality records inside and outside the building. The mortality records inside the building were 7, 6, 6, 4 and 2 individuals in 7, 6, 5, 3 and 4 days respectively. While the mortality records outside the building were: 11 and 8 individuals in 6 and 7 days respectively. The mortality records of mature males during treatment were 7, 5, 3 and 2 male individuals in 6, 7, 5, 3 and 4 days respectively. While the mortality records of mature females during treatment were: 9, 6, 2 and 1 female individuals in 7, 6, 5 and 3 days respectively. The mortality record of immature male during treatment was 2 and 1 male individuals in 6 and 5 days respectively. While the mortality recorded of immature of female numbers during treatment were 2, 1, 1 and 1 female individuals in 6, 7, 4 and 3 days, respectively. The highest mortality numbers for *R. norvegicus* were 17 and 11 individuals in 6th day during treatment and 1st day after treatment (Table 3 and Fig. 1).

Table 3: Evaluation of Super Caid 0.005% against *R. norvegicus* individuals inside and outside building by using food consumption pre- and post-baiting.

Items	Nights	Daily consumption /grams (mean)		Mortality						
		Inside build	Outside build	Inside build	Outside build	Mature ♂	Mature ♀	Immature ♂	Immature ♀	Total
Pre-treatments	1st	12.67	8.98	-	-	-	-	-	-	-
	2nd	12.22	11.51	-	-	-	-	-	-	-
	3rd	4.79	43.17	-	-	-	-	-	-	-
Super Caid treatments	1st	8.92	36.93	0	0	0	0	0	0	0
	2nd	48.34	65.63	0	0	0	0	0	0	0
	3rd	83.82	72.45	4	0	2	1	0	1	4
	4th	88.74	69.55	2	0	1	0	0	1	2
	5th	61.75	20.09	6	0	3	2	1	0	6
	6th	47.20	5.652	6	11	7	6	2	2	17
	7th	28.97	12.44	7	8	5	9	0	1	15
Post-treatments	1st	2.13	18.41	8	3	6	2	2	1	11
	2nd	1.03	7	3	2	3	1	0	1	5
	3rd	2.80	8.94	5	1	3	3	0	0	6

L.S.D (0.05): Treatment: inside = 8.83; outside=10.08. Days: inside=9.54; outside 15.04

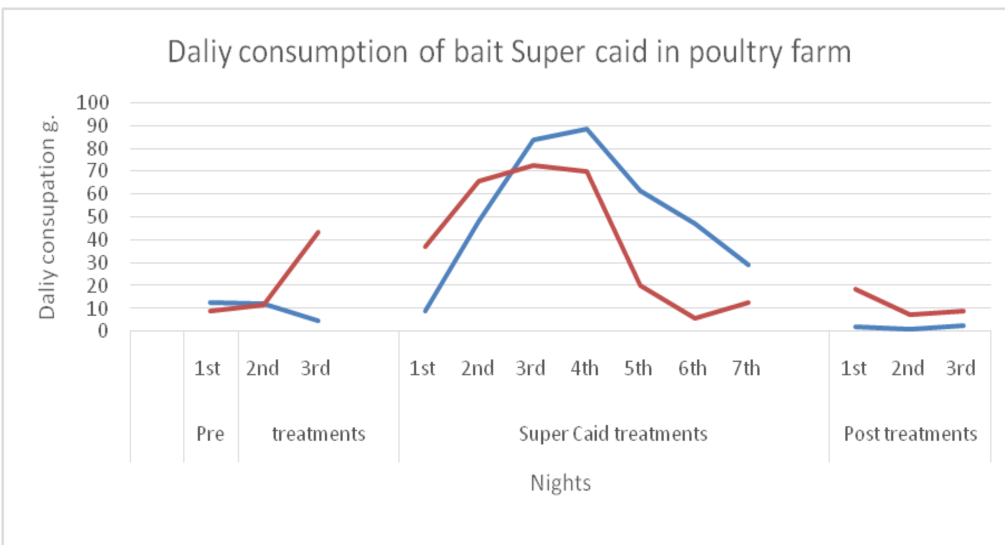


Figure 1: Food consumption pre and post-baiting and bait poison Super Caid 0.005% against *R. norvegicus* individuals under field conditions.

The mean death length in chronic poison was slightly longer than in acute poison for different examined age rat under field condition. Anticoagulants can inhibit two different enzymes of the vitamine K cycle: the epoxide reductase and vitamine K reductase (although some scientists consider these two enzymes were, in fact a single protein). The epoxide reductase was the rate-limiting step and inhibition by anticoagulants will result in the accumulation of vitamine K epoxide, which was not active. The second step was not as critical, since other pathways may lead to the activation of vitamine K, such as the diaphoreses. Inhibition of this vitamin K cycle results in a decreased production of active coagulation factors which, in turn, will result in coagulation disorders and hemorrhages (Berny, 2011). Data in Table (4) showed that the highest mean daily consumption of pre-treatment was recorded 42.21g/3nights cucumber followed by 22.69 g/3 nights of tomato, then 17.57 g/3nightsfalafel and 3.57 g/3 night's lanchon bait. While the highest mean daily consumption post-treatment were recorded by 25.27 g/3night falafel followed by 4.86 g/3night cucumber; then 4.05 g/3nights lanchon and 3.98 g/3 nights tomato bait. In live traps, the results showed that cucumber (3 individuals), tomato (3 individuals) were the highest susceptive followed by falafel (2 individuals) and lanchon (1 individual).

Table 4: Evaluation of live traps against *R. norvegicus* individuals when used food consumption pre-and post-baiting inside building.

Items baits into live traps	Chicken feed pellet								Collect trapped rat/3nights (total)	Reduction (%)
	Pre-treatments(mean)				Post-treatments (mean)					
	1st night	2nd night	3rd night	Total	1st night	2nd night	3rd night	Total	Treatments/3 night	
Cucumber	16.36	4.44	21.41	42.21	1.43	1.13	2.3	4.86	3	92.43
Lanchon	0.02	0.06	3.49	3.57	0	0.5	3.55	4.05	1	61.32
Tomato	0	16.53	6.16	22.69	0	0.4	3.58	3.98	3	78.41
Falafel	2.5	9.97	5.1	17.57	2.42	15.74	7.11	25.27	2	-65.1

L.S.D (0.05): Treatment=1.19, pre and post-treatment=0.69, Days=0.85

The highest reduction of *R. norvegicus* by using Super Caid 0.005% were 79.98 and 46.04 % followed by Zinc phosphide 2% (51.85 and 36.51 %) and Zinc phosphide 3% (67.6 and 32.15 %)) inside and outside the building, when used live trap bait items inside the building, tomato, lanshon, cucumber and falfel the reduction were 78.41, 61.32, 92.43 and -65.1% respectively.

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