

EFFICACY AND STABILITY OF SOME RODENTICIDES UNDER SHELF STORAGE

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Abstract

Anticoagulant rodenticides were studied under shelf storage conditions using chemical and biological assessment. The obtained results showed that storage periods significantly affected on bait acceptance, efficiency and stability of the tested anticoagulants and the effect differed according to bait type, chemical structure of the anticoagulant and period of storage . The attractiveness of Final and "T.R.C" compounds to the albino rats, *Rattus norvegicus*, was less than storm.

Regarding the efficiency of the three tested compounds to albino rat, it was clear that the three anticoagulants completely killed tested animals during all periods of storage, while average consumed bait (gr/ kg b.w) and active ingredient (mg /kg b.w.) increased with the prolongation of the storage period.

On the other hand, the chemical assay of the three anticoagulants during the different periods of storage revealed that their active ingredient slightly decreased with the increasing of storage periods.

INTRODUCTION

Man has always been faced with problems of rodents, which proved to be one of the most important pests all over the world.

At the beginning of 1980's Egypt faced a large rodent problem in agricultural areas. Changes in cultivation system and neglecting rodents control for long time intensified this problem which caused considerable reduction in agriculture products and adversely affected the national income.

Recently, different anticoagulants are used in Egypt to control rodents for agriculture and public health purposes. The condition of used bait stuff is very important and the use of poor quality is often the cause of control failure. When bait becomes moldy, rotten, decayed or dried out, consumption declines until it is totally refused by

rats (Eppo 1975). Fresh baits are most acceptable to rats and mice. Therefore, rodenticides that tolerate storage for comparatively long periods are often enhance or make effective control. Thus, the present work aimed to study the stability of poisoned baits of some anticoagulant rodenticides under shelf storage using chemical and biological methods.

MATERIAL AND METHODS

Three anticoagulant rodenticides were used during the course of this study. These compounds belong to two groups. The first is the new generation of 1-4 hydroxy coumarins and the second is indone - dions 1-4 hydroxy coumarin compounds.

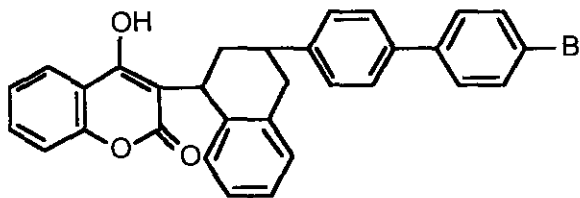
New generation

1.1. Brodifacoum

Common name: brodifacoum

Trade name : Finale, super klerate (0.001% , 0.003% brodifacoum) ready made bait, carried on sound wheat grain and supplied from (ICI) company.

Structural formula :



Chemical name :

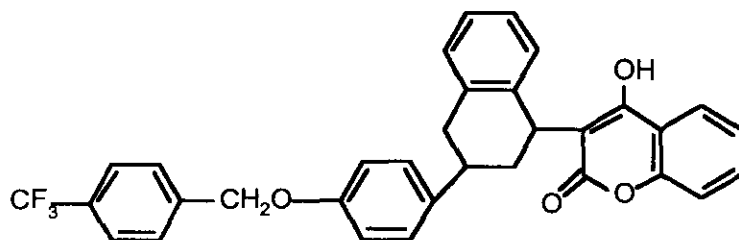
3-[3 - (4 - bromo (1,1 diphenyl /) - 4-yl) -1,2,3,4 tetrahydro - 1 - naphthy] 4 hydroxy coumarin.

1.2. Flocoumafen

Common name : flocoumafen

Trade name : Storm (0.005% flocoumafen) carried on sound wheat grains and supplied from shell company.

Structural formula :



Chemical name :

4- hydroxy -3 - (1,2,3,4 - tetrahydro - 3 - [4 - (4- trifluoro methyl - benzyloxy) phenyl] - 1- naphthyl) coumain.

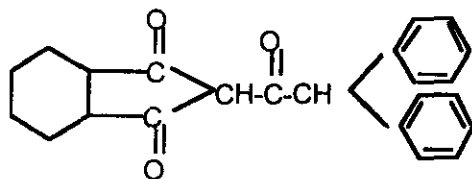
Indanedione compound

1. Diphacinone

Common name : Diphacinone

Trade name : T.R.C (0.005% diphacinone) carried on crushed wheat grains and supplied from tarrmeed international company.

Structural formula :



Chemical name :

(2 - dipheny / acety / indone - 1, 3 dione) .

In this work, 1.e storm (0.005% floucomafen), Final (0.001% brodifacoum) and T.R.C(0.005% diphacinone). The three anticoagulants were carried on sound wheat and freshly supplied from their companies then stored on shelves under laboratory conditions for one year. Bioassay tests were conducted every three months to study the effect of storage on the acceptance and efficacy of these anticoagulants against the albino rat, *R. norvegicus* in addition to another chemoassy tests to determine the active ingredients for each anticoagulant during the time of shelf storage.

1. Bioassay tests

1.1. Effect of shelf storage on rat acceptance to anticoagulant bait:

The acceptance test was carried out using the free choice feeding method by offering 50 grams from standard challenge diet (65 part of crushed maize + 25 part of wheat flour + 5 part of vegetable oil + 5 part of sugar) to the albino rats, *R. norvegicus*. The amount consumed from stored anticoagulants and fresh standard diet by each rat were recorded daily for six days. The placement of the anticoagulant and the fresh diet was changed daily to prevent preference for certain location.

Six sexed replicates each one animal, were used for each treatment. The acceptance of rats towards stored anticoagulants was calculated as follows: (Buckle 1994)

$$\% \text{ Acceptance} = \frac{\text{Amount consumed from stored anticoagulant}}{\text{amount consumed from stored anticoagulant} + \text{amount consumed from fresh diet}} \times 100$$

1.2. Effect of shelf storage on anticoagulant efficacy : Storm, Final and T.R.C were obtained freshly from their producers and stored on shelf in the laboratory for one year. The bioassay test was conducted every three months on the albino rat, *R. norvegicus*. The body weight of rats was recorded at the beginning and the end of the test.

None choice feeding method was used during this work, whereas singly caged animals were offered 50 grams anticoagulant bait for one day in the case of Storm and Final (single dose anticoagulant) and four days for T.R.C (multi dose anticoagulant). The amount consumed was measured and bait consumption was calculated in g / kg b.w. The bait consumption (g / kg b.w.), the active ingredient (mg / kg. b.w.) and the period elapsed until death, in addition to the mortality percentage of rats, were calculated for each treatment.

Chemical Determination: The method designed for the determination of the three tested chemicals are based on their specific absorption of UV - light at certain wave length for each the selected wave length 286 , 310 and 308 nm for diphacinone, flocoumafen and brodifacoum, respectively according to El sheamy and Ramadan (1991) and ICI (1983).

RESULTS AND DISCUSSION

1. Effect of storage on bait acceptance : The effect of storage for different periods on bait acceptance of T.R.C (diphacinone), Final (brodifacoum) and Storm (Flocoumafen) to albino rat *R. norvegicus* is shown in Table 1.

The obtained data revealed that Storm bait was more acceptable to rats than 68.2% baits of T.R.C 50.0 and Final 46.8% anticoagulants when offered freshly as it accepted with and 46.8% for the two anticoagulants . The adverse effect of storage on bait acceptance was more obvious in cases of T.R.C and Final than storm. The acceptance of T.R.C and Final baits drastically decreased with the prolongation of storage periods to 0.33 and 0.26 times in comparison with their percentages at onset of the experimental period, while acceptance of storm only decreased with 0.51 times at the end of the experiment (after 12 month). On the other hand, the drastic effect was obvious after the ninth month of storage in case of storm, while it was recorded after the third month for T.R.C and Final anticoagulants. EL - Deeb, *et al.* (1987) pointed out that the acceptance of rats to two types of crushed maize was significantly decreased with the prolongation of storage period. Also, Johnson (1986) mentioned that flocoumafen bait was still stable and attractive after storage for six months.

2. Effect of storage on anticoagulants efficacy : Data mentioned in Table 2 represent the effect of storage on efficacy of the three tested anticoagulants against the albino rat, *R. norvegicus*. The results obtained showed that all tests rodenticides killed all rats during the different periods of storages and the lethal periods did not significantly differ for all storage periods as they ranged between 5.8 to 70, 5.7 to 7. 3 and 5. 8 to 6.4 days during the whole storage period (12 month).

On the other hand, average consumed bait (gr/kg b.w.) and active ingredient (mg/kg .b.w.) significantly increased with the prolongation of storage period in all cases as the two values were 201.2 & 10.2, 87.6 & 0.77 and 80.89 gr & 4.04 mg /kg b.w for T.R.C final and storm , respectively at the beginning of the trial then gradually increased to be 370.1 & 13.5, 140.8 & 1.91 and 148.40 gr & 6.72 mg/kg b.w. after the 12 month storage period , consequentinely.

Generally, it could be concluded that although degradation of the tested compounds took place after storage, particularly after longer periods, complete mortality of the tested animals occurred. This may be due to the increased amount of bait eaten by the animals. Such increase could account for this complete mortality.

3. Effect of storage on rodenticide stability : Stability of the three tested compounds under conditions of different storage periods is shown in table 3 it is obvious that active ingredient percentages of these anticoagulants were not significantly affected when subjected to the different periods of storage. Active ingredient percentages at T.R.C, final and storm were 0.0067, 0.00104 and 0.0051 in the beginning of experiment, and were 0.0065, 0.00106 and 0.0043 after 12 month, respectively.

It could be concluded that the bioassay tests revealed that the efficacy of the three tested anticoagulants decreased with the prolongation of storage period. This contradiction may be due to method of analysis which could detect only the main structure of these chemicals i.e the coumarin ring it is too easy to distinguish between the parent compound and their degradable products. These degradable chemicals have also the coumarin ring which is less toxic than the parent compound.

Table 1. Effect of storage on acceptance of some anticoagulants for the albino rat, *R. Norvgecus*.

Storage period (months)	Percentage of acceptance		
	T.R.C (Diphacinone)	final (Brodifacoum)	storm (Flocoumafen)
0	50	46.8	68.2
3	43.3	45.9	65.9
6	23.2	17.1	66.7
9	18.7	14.9	60
12	16.5	12.3	35.4

Table 2. Attractiveness and stability of tested anticoagulant baits for the albino rat, *R.norvegicus* during one year storage.

Storage period (months)	T.R.C (Diphacinone)				Final (Brodifacoum)				Storm (Flocoumafen)			
	Mean weight of bait eaten	Mean (a.i) Mg/kg.	Mortality %	Mean days to death	Mean weight of bait eaten	Mean (a.i) Mg/kg.	Mortality %	Mean days to death	Mean weight of bait eaten	Mean (a.i) Mg/kg.	Mortality %	Mean days to death
0	201.2	10.2	100	6.4	87.6	0.77	100	6.3	80.84	4.04	100	6.4
3	287	14.2	100	5.8	97.2	0.97	100	5.7	93.67	4.68	100	5.8
6	329.2	15.7	100	6.7	126.2	1.26	100	7.3	99.21	4.96	100	6.2
9	355.2	17.9	100	6.3	125.1	1.25	100	7.3	129.33	6.49	100	6.4
12	370.1	18.5	100	7	140.8	1.41	100	7	148.4	6.72	100	6.2
L.S.D 0.05	78.021	3.898		1.715	24.839	0.248		1.964	33.02	1.557		1.602

Table 3. Stability of certain anticoagulant rodenticides after different periods of storage.

Storage period (months)	% Active ingredient		
	T.R.C (Diphacinone)	final (Brodifacoum)	storm (Flocoumafen)
0	0.0069	0.00104	0.0051
3	0.0067	0.00165	0.0044
6	0.0058	0.00165	0.0043
9	0.0062	0.00116	0.0044
12	0.0065	0.00106	0.0043

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قابلية وثبات بعض مبيدات القوارض تحت ظروف التخزين

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تمت دراسة مدى فاعلية وثبات بعض مبيدات القوارض تحت ظروف التخزين المختلفة باستخدام طرق التقدير البيولوجية والكيميائية. وقد أثبتت النتائج إن ظروف التخزين قد أثرت على مدى قابلية الفئران لطعوم هذه المبيدات . كما أن فاعلية هذه المبيدات بعد تخزينها قد تأثرت وان هذا التأثير اختلف باختلاف نوع الطعم . والمادة الفعالة وكذلك مدة التخزين. اتضح أن مركب الفينال و T.R.C. كانا أكثر تأثرا لظروف التخزين، بينما لم تتأثر فاعلية هذه المركبات ضد الفأر الالبينو. بعد عملية التخزين زادت كمية المستهلك من طعوم هذه المبيدات والمادة الفعالة بإطالة مدة التخزين أظهر التحليل الكيماوي للمركبات تحت الاختبار بعد تخزينها لفترات مختلفة حدوث نقص في المادة الفعالة مع زيادة مدة التخزين .