STUDIES ON BAIT PREFERENCE AND ACCEPTANCE OF FLOCOUMAFEN IN *Rattus rattus* INFESTING POULTRY FARMS AND GODOWNS

MANJU MATHUR, A.P. JAIN, NISHA KASHYAP, and FARZANA PARVEEN, Central Arid Zone Research Institute, Jodhpur–342003, India

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INTRODUCTION

The black rat (*Rattus rattus*) has global distribution with 570 forms (Walker 1940). However, in India it is represented by 16 sub-species (Biswas and Tiwari 1969) with *R.r. rufescens* as most common commensal rodent (Barnett and Prakash 1975). It distinctly occupies rural and urban areas in Rajasthan. Besides infesting human dwellings rats occupy poultry farms, godowns, shops, flour mills, etc. With increase in poultry farming the rat problem has become critical and so is the fate of farm produce being stored at farmers' godowns which are small, non-scientifically constructed and non-rodent proof.

Often it is recommended that poultry feed may be used as baiting medium (Bhardwaj 1983) to contain rodent menace in poultry farms. Poultry raisers often reported that desired results are not obtained if poultry feed is used as bait. Therefore, it is thought pertinent to investigate under laboratory conditions as to how black rats behave when; 1) these are directly exposed to selected cereal baits and poultry feed, 2) selected baits with additives like vegetable oils, sugar and salt, 3) to see efficacy of 0.005 percent flocoumafen in most preferred baits.

MATERIALS AND METHODS

Rattus rattus rufescens were live trapped from poultry farms and from godowns. These were acclimated to laboratory conditions for over a week. Rats trapped from poultry farms were provided poultry feed and the rats from godowns were exposed to pearl millets (*Pennysetum typhoides*) during acclimation period. For each set of experiment 10 animals of each sex were used.

To every rat a set of three candidate baits was provided for six days. These three baits were selected out of 10 candidate baits through random number tables. Average daily intake (ADI) was recorded by weighing the remnant baits provided to individual rat. Consumed baits were replenished daily with a fresh series of baits. For comparisons all ADI were converted to b/100 g body weight.

In first test all the major cereals, pulses and poultry feed were exposed. However, in the next test first five top ranking baits from first test were tested along 2 percent groundnut oil (*Arachis hypogea*) and sesame oil (*Sesamum indicum*) whereas, in test III one percent salt and sugar were added along with the most preferred oil. But in final test 0.005 percent flocoumafen was added to topmost ranking bait and exposed for a day with poultry feed as alternate choice. The same treatment was given to rats from godowns assuming that if these rats migrate to poultry farms what would be their behavioral response. Furthermore in a separate set of experiment major cereals of the area, poultry feed and arachis oil along with one percent sugar and salt were exposed. The candidate baits of this test are those which are generally used by poultry raisers to contain rodent menace.

Data were subjected to statistical analysis and for comparisons students "t" test was applied. Energy values of all the foods were also computed to understand behavior of rats in regulation of energy intakes.

RESULTS

Test I

Poultry rats preferred pearl millet (*Pennisetum typhoides*), sorghum and wheat, whereas godown rats like sorghum, pearl millet and wheat respectively in the order mentioned. However, statistical difference was observed in their consumption of pearl millet ($p > 0.01$). Interestingly, poultry feed rated at 7th position by both godown and poultry rats (Table 1). Consumption of rice and pulses was found to be significantly lower ($p > 0.05$) than the preferred ones.

Test II

Poultry rats preferred sorghum with arachis oil, whereas pearl millet is liked with combinations of both the oils. Surprisingly the consumption of all the test food items is reduced to half as compared to previous test. Rice with arachis oil rated at the lowest (Table 2). However, in case of godown rats, pearl millet with arachis oil and sorghum with both the oils are preferred (Table 2). Consumption of wheat and bengal gram (*Cicer arietinum*) was reduced to half as compared to previous test. Consumption of pearl millet registered increase but not significant.

Test III

Poultry rats again liked sorghum with both the oils and sugar. Pearl millet attained second position with sesame oil and sugar. However consumption of pearl millet is reduced by 50 percent and that of sorghum by 30 percent. Consumption of bengal gram (chana) also registered a declining trend (Table 3). Interestingly godown rats also behaved similar to poultry rats in preferring the baits. However, there was no significant difference in the consumption of sorghum and pearl millet in rats from both the habitats. Consumption of bengal gram further increased in godown rats.

Test IV

Results evidently indicated that poultry rats liked pearl millet with arachis oil and sugar. Here 50 percent of the rats succumbed to 0.87 mg/kg dosage of flocoumafen with days to death ranging from 3-15. In case of godown rats, however, sorghum with sesame oil and sugar was preferred. Flocoumafen at the dosage of 1.18 mg/kg registered 62.5 percent kill with 4-8 days time to death.

Test V

Poultry rats preferred pearl millet with arachis oil and salt at the top of preference hierarchy followed by poultry feed with sugar and salt at second and third positions, respec-

Table 1. Showing consumption of poultry feed, cereals and pulses.

Baits	Consumption (g) (Mean ± SE)		Order of preference	
	Godown rats	Poultry rats	Godown rats	Poultry rats
1. Bajra (*Pennisetum typhoides*)	4.58±0.37	7.40+0.64	2	1
2. Poultry feed	1.67±0.20	1.68±0.21	7	7
3. Wheat (*Triticum aestivum*)	3.12±0.50	4.85±0.69	3	3
4. Jowar (*Sorghum vulgare*)	4.61±0.55	5.72±0.71	1	2
5. Maize (*Zea Mays*)	0.93±0.49	2.13±0.63	9	6
6. Moong (*Vigna radiata*)	1.79±0.26	1.50±0.38	6	9
7. Rice (*Oryza sativa*)	2.12±0.34	3.72±0.62	5	4
8. Moth (*Phaseolus aconitifolius*)	1.35±0.28	3.56±0.77	8	5
9. Guar (*Cyamopsis tetragonoloba*)	0.72±0.09	0.55±0.13	10	10
10. Chana (*Cicer arietinum*)	2.51±0.43	1.51±0.47	4	8

tively. The godown rats, however, preferred pearl millet at first and second choice along with salt and sugar respectively, whereas poultry feed + arachis oil + sugar was rated third position.

DISCUSSION

Selection of Suitable Bait

Irrespective of habitat in all the tests conducted the rats preferred cereals, especially the millets (Tables 1 to 3). The poultry feed, however, stood at 7th position in comparison to cereals and pulses (Table 1). This contradicts previous report that poultry feed may be used as bait in poultry farms (Bhardwaj 1983). Interestingly, cereals recorded 5 times more consumption than that of poultry feed in Punjab (Parshad et al. 1987, 1991). These authors further claimed that availability of plain cereal bait (alternate bait) along zinc phosphide bait seriously affected mortality rates. Trials conducted in Andhra Pradesh and Punjab indicated a knock down of 50 percent rats (Jain and Mukherjee 1982); 87 and 96 percent kill (with and without birds) of poultry rats (Parshad et al. 1991).

Further, place preference was observed to affect the consumption of baits in poultry farms (Jain and Pawde 1981). Since zinc phosphide is also quite toxic to poultry birds (Lund 1981) and rats develop bait shyness towards it lasting up to 75 days (Prakash et al. 1975), some other chemical is required to be tested. Flocoumafen, however, proved quite effective against *Rattus rattus* (Jain et al. 1990). Results of present study also indicated that poultry rats succumbed to single feeding of flocoumafen (0.005 percent) to the extent of 50 percent in choice test, whereas for godown rats the figure is 62.5 percent.

Role of Additives in Bait

Increase in bait consumption due to addition of oils is reported for *Rattus rattus* (Khan 1974). However, observations of present study indicate a drop in food acceptance (Table 2). This reduced intake could largely be attributed to regulate the calorie intake (energy balance).

Behavioral Response of Rats

Total daily intake—Average daily intake revealed that rats from poultry farm and godowns behaved exactly the same, when cereals, poultry feed and additives like vegetable oils, sugar and salt were given (Test V). Regular ups and downs are observed, i.e. second, fourth and sixth day recorded increase and on rest of the days a significant decrease ($p>0.01$) is registered. Interestingly, the average daily intake and so the energy intakes are quite high as compared to tests I to IV. The situation is not quite happy for pest control operators as the intakes are fluctuating to a very great extent.

Observations of other tests evidently reveal that for poultry rats immediate drop in consumption of cereal baits is recorded and it is only after the third day that a plateau is reached. Thus, a three day pre-baiting is necessitated. Similarly, observations are recorded on *Rattus rattus* dwelling in poultry farms (Jain and Mukherjee 1982).

Interestingly, when oils are added to cereals a steady increase up to the fifth day is observed in poultry rats and godown rats. However, increase is more prominent in poultry rats. Addition of salt and sugar apparently did not make any impact when ADI is considered.

Energy Intake—The energy intakes varied from 7.80 k cal/100 g body wt/24 hours when fed on cereals and oils to 13.79 k cal/100 g body weight/24 hours when cereals, poultry feed, oils and sugar and salt were provided to poultry rats. The same varied from 8.02 k cal/100 g body wt/24 hours to 13.01 k cal/100 g body weight/24 hours in godown rats. The low calorific requirement of these commensal rats in comparison to *Rattus cutchicus* and *Meriones hurrianae* (36 k cal/100 g body wt/24 hours) is probably due to their reduced activities and the fact that they do not dig burrows. Also, searching for food is not as difficult when compared to other field species of the desert eco-system (Jain et al. 1975). Similar results have been recorded for *Rattus rattus* (Sridhara and Krishnamoorthy 1977).

SUMMARY

The usually poor intake of poison baits by the rodents infesting a number of poultry farms and around Jodhpur city induced us to study their bait preferences. House rats, *R. rattus rufescens* were collected from poultry farms and food grain godowns. After acclimatization in laboratory cages, several combinations (using a random table) of cereals (millets, sorghum, wheat, rice, maize, gram), pulses and poultry feed,

Table 2. Showing consumption of cereals with oils.

Baits (whole grains + 2% arachis oil or sesame oil)	Consumption (g) (Mean ± SE)	Rank
(a) Godown Rats		
1. Jowar + 2% Arachis Oil	4.75±0.96	2
2. Jowar + 2% Sesame Oil	4.60±0.44	3
3. Bajra + 2% Arachis oil	5.78±0.30	1
4. Bajra + 2% Sesame Oil	4.46±0.34	4
5. Wheat + 2% Arachis Oil	1.57±0.26	8
6. Wheat + 2% Sesame Oil	1.73±0.26	7
7. Chana + 2% Arachis Oil	1.82±0.22	5
8. Chana + 2% Sesame Oil	1.07±0.15	10
9. Rice + 2% Sesame Oil	1.77±0.22	6
10. Rice + 2% Sesame Oil	1.19±0.16	9
(b) Poultry Rats		
1. Bajra + 2% Arachis Oil	2.38±0.57	3
2. Bajra + 2% Sesame Oil	2.72±0.52	2
3. Jowar + 2% Arachis Oil	3.15±0.62	1
4. Jowar + 2% Sesame Oil	2.05±0.59	6
5. Wheat + 2% Arachis Oil	2.03±0.58	7
6. Wheat + 2% Sesame Oil	2.06±0.60	5
7. Rice + 2% Arachis Oil	1.43±0.25	10
8. Rice + 2% Sesame Oil	1.49±0.29	9
9. Moth ± 2% Arachis Oil	1.98± 0.49	8
10. Moth + 2% Sesame Oil	2.11±0.97	4

with and without different types of edible oils, salt and sugar were provided to them in individual cages in multiple choice tests. Each trial was carried out for six days and daily consumption of various foods was recorded.

The pooled data reveal that rats affected from poultry farms which were accustomed to thrive upon poultry feed, significantly ($p>0.01$) preferred millet + 2% arachis oil + 1% sugar to poultry feed whereas those captured from godowns accustomed to thrive upon cereals, preferred sorghum + 2% sesame oil + 1% sugar. The significance of the observed diversity in bait preferences of *R. rattus* in undertaking control operations is discussed.

Flocoumafen at 0.005% was mixed in the above mentioned two most preferred baits and was provided to *R. rattus* from both the habitats along with unpoisoned poultry feed in separate containers. Mortality rate after one day exposure to the poisoned baits was 50% and 62.5% in poultry and godown rats respectively. Rats from both the habitats consumed more flocoumafen bait than the unpoisoned poultry feed. These experiments indicate that poison baiting in poultry farms should be carried out with the preferred food as the carrier of the poison and not poultry feed, as is usually done.

Both poultry and godown rats registered low energy intake as compared to field rodents probably due to living on roofs (no burrow making) and thriving on easily accessible food resources thereby avoiding long distance movements as field rodents normally do.

Table 3. Showing consumption of various cereals along with oils, salt and sugar.

Baits (whole grains + 2% oil + 1% salt or sugars)	Consumption (g) (Mean ± SE)	Rank
(a) Godown Rats		
1. Bajra + 2% Arachis Oil + 1% salt	2.13±0.39	7
2. Bajra + 2% Arachis Oil + 1% sugar	2.62±0.50	5
3. Jowar + 2% Arachis Oil + 1% salt	2.71±0.43	4
4. Jowar + 2% Arachis Oil + 1% sugar	3.13±0.39	2
5. Jowar + 2% Sesame Oil + 1% salt	2.47±0.57	6
6. Jowar + 2% Sesame Oil + 1% sugar	3.22±0.56	1
7. Bajra + 2% Sesame Oil + 1% salt	1.51±0.40	8
8. Bajra + 2% Sesame Oil + 1% sugar	12.96±0.48	3
9. Chana + 2% Arachis Oil + 1% salt	1.18±8.25	10
10. Chana + 2% Arachis Oil + 1% sugar	1.21±0.20	9
(b) Poultry Rats		
1. Jowar + 2% G.N. Oil + 1% salt	1.69±0.40	6
2. Jowar + 2% G.N. Oil + 1% sugar	2.62±0.55	4
3. Bajra + 2% Sesame Oil + 1% salt	2.45±0.39	5
4. Bajra + 2% Sesame Oil + 1% sugar	3.65±0.66	2
5. Bajra + 2% Arachis Oil + 1% salt	2.64±0.57	3
6. Bajra + 2% Arachis Oil + 1% sugar	4.31±0.72	1
7. Moth + 2% Sesame Oil + 1% salt	1.31±0.49	8
8. Moth + 2% Sesame Oil + 1% sugar	1.41±0.44	7
9. Wheat + 2% Sesame Oil + 1% salt	1.06±0.38	9
10. Wheat + 2% Sesame Oil + 1% sugar	0.88±0.20	10

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