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Laboratory evaluation of poison carrier for the control of Indian gerbil, *Tatera indica* Hardwicke

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Abstract. *Tatera indica*, a common rodent pest of Indian agriculture, quickly develops poison aversion and bait-shyness towards zinc phosphide, the only acute rodenticide known to farming community. For managing residual population of field rodents, alternate baits are, therefore, required. The present study gives the results of bait preference studies conducted on *T. indica*.

Keywords. *Tatera indica*; poison carrier; bait preference; additives; choice test; Indian gerbil; energy budget.

1. Introduction

Poisoning is the humane method of rodent control (Fitzwater and Prakash 1977) but implementation of the actual management technology requires thorough knowledge of an appropriate bait-carrier of poison. Since rodents of Indian agriculture develop poison aversion and bait-shyness towards zinc phosphide, the only acute stomach poison widely used for field rodent management in India (Prakash and Jain 1971; Prakash *et al* 1975), it becomes more pertinent to work out new effective poisons as well as alternate poison carriers.

The present investigation embodies results of bait preference studies conducted on *Tatera indica*, a common rodent pest of Indian agriculture.

2. Material and methods

Bait preference test was conducted with 10 gerbils each lodged in individual laboratory cages. In free choice tests (multiple choice), three baits, selected from 10 candidate baits with aid of random number tables, were exposed to every gerbil for six days continuously. Consumption of each bait was measured daily and replaced with a new series of baits the following day. In no choice or single choice tests, common foodgrains like bajra, jowar and wheat, were exposed singly to each gerbil. Average daily intake (ADI) of each bait was calculated at the end of each test, after transforming the absolute consumption values to g/100 g body weight of the individual gerbil. Vegetable oils, salt and sugar were also added and exposed. Water was available *ad libitum*. All tests were conducted according to the following scheme. (a) Free-choice tests-whole grains; cracked grains; whole grains *vs* cracked grains; whole grains *vs* flours; whole grains *vs* roasted grains; whole grains + oils; whole grains + oils + salt and sugar; cracked grains + oils; cracked grains + oil + salt and sugar; flours + oils; flours + oil + salt and sugar (b) No choice tests—bajra; jowar; wheat; and (c). Top ranking baits from each test. Other patterns of evaluation are as described earlier (Jain *et al* 1974, 1975; Anon 1981).

Table 1. Consumption of food grains (g/100 g body weight, Mean±S.E.) by *T. indica.*

Foodgrains	Whole grains	Energy (kJ)	Cracked grains	Energy (kJ)
Bajra (*Pennisetum typhoides*)	3.79±0.62	57.4	3.26±0.30	49.3
Barley (*Hordeum vulgare*)	4.65±0.53	65.6	3.23±0.33	45.5
Bengal gram (*Cicer arietinum*)	3.80 ±0.53	57.4	2.27 ± 0.34	34.3
Guar (*Cyamopsis tetragonoloba*)	0.41 ±0.03	–	1.68 ± 0.29	–
Jowar (*Sorghum vulgare*)	1.09 ±0.12	15.9	1.34 ± 0.23	19.6
Maize (*Zea mays*)	5.72 ±0.69	82.1	2.14 ± 0.31	30.7
Green gram (*Vigna radiatus*)	3.07 ±0.53	43.0	3.33 ± 0.30	46.7
Moth (*Phaseolus aconitifolius*)	3.52 ±0.66	48.7	3.47 ± 0.49	48.6
Black gram (*Phaseolus radiatus*)	2.12 ±0.36	29.7	2.25 ± 0.30	32.7
Wheat (*Triticum aestivum*)	6.05 ±0.80	87.9	3.45 ± 0.31	50.1
average (kJ)/100 g body weight/24 hr		54.20±18.06		39.72±13.24

3. Results

3.1 *Whole grains*

Wheat (*Triticum aestivum*), maize (*Zea mays*) and barley (*Hordeum vulgare*) were preferred to all other grains tested (table 1). However, there was no significant difference between consumption of wheat and maize; and wheat and barley ($t=0.31$ and 1.45 respectively). Gerbils preferred large-sized maize or long grains of wheat as compared to small and round grains of pearl millet (*Pennisetum typhoides*), jowar (*Sorghum vulgare*), green gram (*Vigna radiatus*) and moth (*Phaseolus aconitifolius*).

3.2 *Cracked grains*

Among cracked grains, gerbils liked moth>wheat>green gram>pearl millet >barley without any significant difference between their consumptions ($t=0.1$, 0.2, 0.4 and 0.5 respectively) as compared to top-rated moth (table 1).

3.3 *Whole grains vs cracked grains*

Cracked grains were clearly preferred to whole grains except bajra (table 2). Gerbils choose wheat followed by maize and bengal gram (*Cicer arietinum*) without any significant difference between their consumptions ($t=0.3$, 0.5 respectively). Antelope rats too maintained preference for the same grains except that bengal gram replaced barley (taole 2).

3.4 *Whole grains vs flours*

Among flour forms bengal gram>wheat>maize was favoured without any statistically significant difference between their respective consumptions ($t=$ 0.31, 0.47, table 2). Interestingly, these top ranking foodgrains change their positions in the preference hierarchy with change in their forms or textures.

3.5 *Whole grains vs roasted grains*

Rodents clearly preferred roasted grains to dry whole grains in as much as that the relative consumption of roasted jowar (*Sorghum vulgare*) was significantly more from its dry grain form ($t=6.46$, $P>0.001$, table 3).

Table 2. Relative consumption (g) of various forms of food grains by *T. indica*.

Food items	Whole grains *vs* cracked grains				Whole grains *vs* flours			
	Whole Mean±SE	Energy (kJ)	Cracked Mean±SE	Energy (kJ)	Whole Mean±SE	Energy (kJ)	Flours Mean±SE	Energy (kJ)
Bajra	2.16±0.46	32.7	2.12±0.50	32.1	2.01±0.49	30.4	1.24±0.28	18.7
Barley	1.88±0.39	26.5	2.08±0.31	29.3	2.92±0.36	41.2	1.90±0.42	26.7
Bengal gram	2.47±0.36	41.5	3.26±0.55	49.2	3.56±0.54	53.8	3.86±0.47	58.3
Maize	2.73±0.53	39.1	3.30±0.52	47.3	1.74±0.25	24.9	2.95±0.43	42.3
Wheat	2.58±0.52	37.4	3.82±0.56	55.4	2.11±0.33	30.9	3.28±0.47	47.6
Average (kJ)/100 g body wt/24 hrs		35.44±2.66		42.66±5.09		36.20±5.69		36.72±8.68

Table 3. Relative consumption of grains (g, Mean±S.E.) and their respective roasted forms by *T. indica*.

Baits	Av. daily intake (ADI)	Per cent consumption	Palatability rank
Bajra, grain	2.08±0.52	10.82	6
Bajra, roasted grain	2.29±0.36	11.91	5
Bengal gram, grain	1.75±0.37	9.10	7
Bengal gram, roasted grain	2.58±0.38	13.42	2
Jowar, grain	0.50±0.11	2.60	10
Jowar, roasted grain	1.17±0.27	6.08	9
Maize, grain	1.30±0.23	6.76	8
Maize, roasted grain	2.34±0.40	12.17	4
Wheat, grain	2.56±0.47	13.31	3
Wheat, roasted grain	2.65±0.58	13.78	1

3.6 *Additives*

These gerbils clearly made an easy choice for sesame oil (*Sesamum indicum*) against groundnut oil (*Arachis hypogea*) among all forms of foodgrains *viz* whole grains, cracked grains and flours (tables 4, 5 and 6).

3.7 *Trial among top ranking baits*

Except for wheat flour + 10% sesame oil + 1% sugar, which is expensive, all the top ranking food items were exposed together. Maize flour along with 10% sesame oil appeared to be the most preferred bait for this gerbil (table 7). No significant difference is, however, noticed between the top ranking bait (maize flour + 10% sesame oil), cracked wheat and wheat grain + 2% sesame oil which occupied 2nd and 3rd positions respectively ($t=1.53$ and 1.48 respectively). However, when locally grown grains were evaluated the preference was wheat > bajra > jowar.

3.8 *Energy budget*

Gerbils consumed different kinds of food in varied forms and in different combinations of oil, salt and sugar. Thus, rodents maintained their body weight at a minimum of 15.9 kJ / 100g body weight / 24 hr on jowar to a maximum of 86.1 kJ / 100g body weight / 24 hr when fed on wheat (tables 1-8).

4. Discussion

4.1 *Selection of bait in no-choice and free-choice tests*

No significant differences could be observed in the average daily intakes (ADI) of the same food when provided in no-choice and free-choice tests. But relatively more food was consumed in no-choice or single-choice test (table 8). Therefore, single food item should be used to bait these rodents. This will benefit in two ways (i) more poison bait will be consumed (ii) in case of exposing poison in a mixture of bait materials; due to development of baitshyness, we are left with no other preferred bait to tackle residual population as these rodents will normally reject even the individual component of the mixture on subsequent exposures. It is also observed that *Tatera* sampled every food item. This sampling led to selection of superior food, *i.e.*, wheat was preferred in 7 out of 13 tests which is also supported

Table 4. Relative food consumption (g, Mean ±S.E.) with oils by *T. indica*.

Food item	Whole grains + 2%				Cracked grains + 2%			
	Arachis oil	Energy (kJ)	Sesame oil	Energy (kJ)	Arachis oil	Energy (kJ)	Sesame oil	Energy (kJ)
Bajra	2.79±0.65	44.22	2.43±0.63	38.49	1.35±0.23	21.38	1.27±0.24	20.00
Barley	2.98±0.46	40.09	3.05±0.41	45.10	1.57±0.30	23.22	2.02±0.27	29.87
Bengal gram	3.13±0.57	49.45	2.84±0.56	44.89	–	–	–	–
Green gram	–	–	–	–	2.52±0.37	37.07	1.66±0.32	24.39
Maize	3.47±0.46	52.21	3.45±0.47	51.92	–	–	–	–
Moth	–	–	–	–	2.14±0.31	31.12	2.39±0.42	34.79
Wheat	3.49±0.49	53.09	4.01±0.54	61.04	1.73±0.27	26.31	2.36±0.31	36.19
Average kJ / 100 g body weight / 24 hr		47.79±5.51		48.28±3.84		27.82±2.84		29.06±3.06

Table 5. Relative consumption (g / 100 g body weight / 24 hr, Mean±S.E.) of flours with oils, sugar and salt by *T. indica*.

Food item	Flours + 10%				Flours + 10% sesame oil + 1%			
	Arachis oil	Energy (kJ)	Sesame oil	Energy (kJ)	Salt	Energy (kJ)	Sugar	Energy (kJ)
Bajra	1.85±0.43	34.9	3.20±0.49	60.6	1.85±0.31	35.0	1.86±0.43	35.0
Barley	1.86±0.41	33.2	2.05±0.41	36.6	0.90±0.21	16.0	1.46±0.28	26.0
Bengal gram	3.70±0.49	51.7	2.93±0.37	55.3	2.62±0.42	49.4	3.09±0.29	58.3
Maize	3.44±0.50	62.3	3.74±0.47	67.8	1.97±0 33	39.7	2.38±0.33	43.1
Wheat	3.44±0.39	62.9	3.25±0 37	59.4	3.14±0.27	57.4	3.46±0.52	63.3
Average kJ / 100 g body weight / 24 hr		49.00±6.44		56.00±5.25		38.72±7.10		45.14±7.00

Table 6. Relative consumption of grains (g/100 g body weight/24 hr, Mean ±S.E.) with oil, salt and sugar by *T. indica*.

Food item	Whole grains + 2% arachis oil + 1%				Cracked grains + 2% sesame oil + 1%			
	Salt	Energy (kJ)	Sugar	Energy (kJ)	Salt	Energy (kJ)	Sugar	Energy (kJ)
Bajra	2.79±0.92	44.22	2.62±0.70	41.50	0.68±0.18	10.75	1.66±0.25	26.27
Barley	2.61±0.39	38.74	2.97±0.39	43.22	1.67±0.38	24.72	1.55±0.20	22.50
Bengal gram	3.27±0.61	51.67	3.02±0.50	47.73	–	–	–	–
Green gram	–	–	–	–	1.16±0.16	17.02	1.25±0.24	18.36
Maize	2.26±0.30	33.97	3.24±0.41	48,78	–	–	–	–
Moth	–	–	–	–	1.88±0.30	27.32	1.99±0.38	29.34
Wheat	5.01±0.60	76.27	4.71±0.56	71.67	1.08±0.23	16.40	1.32±0.31	20.04
Average kJ/100 g body wt/24 hr		48.96±7.45		48.24±4.80		19.22±2.99		23.28±2.00

Table 7. Relative consumption (g/100 g body weight/24 hr, Mean±S.E.) of best ranking food items from each test.

Food items	Av. daily intake	Per cent consumption	Palatability index
Bengal gram, flour	1.61±0.36	9.9	6
Green gram, cracked +2% arachis oil	1.44±0.23	8.6	8
Maize flour +10% sesame oil	2.92±0.48	17.5	1
Moth, cracked grain	0.72±0.18	4.3	10
Moth, cracked grain +2% sesame oil +1% sugar	1.03±0.22	6.2	9
Wheat, cracked grain	1.94±0.43	11.6	2
Wheat, roasted grain	1.80±0.39	10.8	5
Wheat, whole grain	1.67±0.32	11.0	4
Wheat, whole grain+2% arachis oil	1.94±0.46	11.6	2
Wheat, whole grain +2% arachis oil +1% salt	1.53±0.26	9.2	7

Table 8. Comparison of relative consumption of locally grown food grains in single and multiple (free) choice tests.

Food grains	ADI (g)/100 g body weight (Mean± S.E.)				't' between *a* and *b*
	Multiple choice (*a*)	Energy (kJ)	Single choice (*b*)	Energy (kJ)	
Bajra	3.79±0.62	57.20	5.38±0.27	81.25	1.47 NS
Jowar	1.09±0.12	16.06	2.55±0.17	37.19	1.07 NS
Wheat	6.05±0.80	87.54	5.94±0.18	86.14	0.006 NS
Average kJ/100g body wt/24 hı		53.60±20.78		68.19±15.58	NS=Not Significant

from field observations that gerbils inflict severe pre-harvest losses to standing wheat crop (Advani *et al* 1982). Moth in two tests and green gram and bengal gram also appeared in the list of top choice food items once in these 13 tests. Thus, *T. indica* is not a selective feeder, this behaviour is quite important in two ways (i) gerbils surviving a poisoning campaign using zinc phosphide, apparently develop bait- shyness (Prakash and Jain 1971) and discriminate bait (single food or mixture as the case may be) subsequently. (ii) dietary variance is also advantageous in a desert ecosystem where no regular food supply is ensured; field rodents are bound to change over to the available food resource and gerbils have been observed even to consume insects in appreciable amounts (Prasad 1954; and Prakash 1962).

In the final test, wherein all the top ranking bait items from different tests were exposed together, gerbils preferred (i) maize flour+ 10% sesame oil (ii) wheat+ 2% sesame oil (iii) wheat; and (iv) bajra grains. Hence, these food items can be effectively used for baiting these rodents.

4.2 *Role of additives*

Addition of oils retarded the ADI of most of the foods provided except for the flours. As observed earlier, *T. indica* being omnivore tend to select the food on the basis of its nutritive or energy value. Therefore, gerbils consumed less of oil added foodgrains to regulate the energy intake (Lepkovsky 1948). Thus, there is no significant difference in the energy obtained from the consumption of more food grains (without oil) than from foodgrains consumed in low quantity (with oils). The consumption of flours did not decrease when oils are added, yet there is no significant difference in the energy intake from the flours and whole grains (tables 1 and 5 respectively). Gerbils clearly preferred sesame oil (*Sesamum indicum*) to groundnut oil (*Arachis hypogea*) with whole grains, cracked grains and flours. In the desert tract, wherever possible, sesame is grown and this is vividly reflected in the preference of this field rodent.

Gerbils categorically preferred salt with whole grains and sugar with cracked grains and flours. In case of cracked grains addition of salt and sugar retarded the intakes (even in terms of energy intake) and therefore, these additives should be used with utmost care. It will even be better not to use salt and sugar in the bait formulations as during field operation / poisoning treatments these additives go beyond control which may adversely affect the ingestion of baits.

4.3 *Energy budget*

Metabolic rate is positively correlated with home range (McNab 1963) and the small home range of *T. indica*, therefore, indicates low basal metabolic rate (BMR = 0.87 at 86.8 g body weight, Goyal and Ghosh 1982). However, low BMR ensures saving of pulmonary water loss (Goyal *et al* 1982) which is of considerable magnitude in hot desert environments. *T. indica* also exhibits lowest conductance value among the Indian desert rodents studied which further accounts for reduction in loss of energy. Besides this, these gerbils spend less time (22%) in foraging outside their nests which not only saves much of the energy but also avoids depredation (Goyal 1981). Thus, *T. indica* in a hot desert environment attains proper *niche* utilization by adopting to nocturnality; constructing simple burrows; low BMR mass function; low conductance mass function at a very low energy budget (Av. 35.4 to 56 kJ / 100g body weight / 24 hr) as compared to very high energy budget (246.9 to 254.5 kJ / 100 g body weight / 24 hr) required by same species (*T. indica*) in a non-desert (humid) environment (Vasanthakumari and Khan 1978).

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