Pakistan J. Zool., vol. 47(5), pp. 1387-1391, 2015.

Laboratory Evaluation of Some Bait Bases to Formulate Palatable Bait for the Control of Short-Tailed Mole Rat, *Nesokia indica*

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Abstract.- The short-tailed mole rat *(Nesokia indica)* was tested to determine the preference towards various cereals viz. wheat, rice, maize, millet, peanut and sunflower seed. The cereals were studied in single-feed, two feed and multiple feed choice tests comprising of twenty-two various combinations. It was evident from no-choice and choice tests that the rat preferred the rice most followed by the wheat, millet, peanut, maize and sunflower seed. It was concluded from the study that rice has clear likeness of *Nesokia indica* over other cereals (35.47%) when offered as single or in combinations with wheat (26.22%) being a preferred and cost- effective bait base.

Key words: *Nesokia indica*, palatability, cereal.

INTRODUCTION

The short-tailed mole rat, *Nesokia indica* Gray, 1832 is largely a palaearctic rodent and is widely distributed in India, Pakistan, Iran, Iraq, Afghanistan, Egypt, Syria, Northern Arabia, Chinese Turkistan and Southern Russian Turkestan (Walker, 1975). In Pakistan, it is a rodent pest of economic importance and inflicts extensive damage to wheat, rice and sugarcane crops (Greaves *et al.*, 1975; Beg *et al.*, 1981; Fulk *et al.*, 1981). In Pakistan *N. indica* is extremely widespread throughout the cultivated fields where there is irrigation in Sindh and Punjab (Fulk *et al.*, 1981) and in most of the broader valleys of Baluchistan (Roberts, 1997). In the non-crop land of Baluchistan, *N. indica* is largely herbivorous in diet (Ahmed *et al.*, 2007). In the orchards of Baluchistan about 93% of the diet of the rat was due to plants and the remaining 7% was due to insects (Mian *et al.*, 1987). Roberts (1997) also recorded its presence around Bannu, Kohat, Mardan and Peshawar and probably in the valley of Swat. Walker (1964) gave its upper limit distribution at 1500 m elevation. In the Punjab and Sindh plains, *N. indica* was originally confined to the margins of rivers above flood level. With the introduction of irrigational canal systems, the cultivated parts turned into a suitable habitat and this species is now probably the most abundant mammal rodent pest in Pakistan followed by *Bandicota bengalensis* (Taber *et al.*, 1967).

Several methods are being used in the world to minimize rodent losses but poison baiting is still considered as the main method to control rodent pests. Any rodent control program cannot be successful, if the poison bait is not well accepted by the rats. Different species of rats differ in their diet and preferences. A thorough knowledge of the preferred food and feeding behavior of the pest species may be helpful in planning control strategies (Adamczewska-Andrezejewska *et al.*, 1979). In the present study efforts have, therefore, been made to determine the most preferred bait base to formulate a suitable carrier for the poison bait for the successful control of this rodent species infesting date-palm orchards in Chaghai and Kharan districts of Baluchistan Province of Pakistan.

MATERIALS AND METHODS

Collection of rats

The short-tailed mole rats were live captured through single catch trap from Nok-Kundi, district Chaghai, Baluchistan. The rats after arrival in the laboratory were sexed and individually caged for

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0030-9923/2015/0005-1387 $ 8.00/0
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acclimation for one month before undertaking various tests. Pregnant, lactating and sub-adults were discarded. The rats were fed on a laboratory diet containing wheat, rice maize and fish meal before and between various tests. Water was provided *ad-libitium.*

Experimental design

Ten rats of each sex with average weight of 293g were kept in separate mesh cages of size 30x20x10 cm and were provided with nest box and nesting material. Six cereals *viz.,* wheat, rice maize, millet, peanut and sunflower seed were used for single feed.

For two-feed test rice was fed with wheat, maize, millet, peanut, and sunflower seed in separate combination. Likewise wheat was fed with maize, peanut, millet and sunflower seed in separate combinations. Similarly, maize was fed with peanut, millet, sunflower seed and millet was fed with sunflower seed and peanut and sunflower seed was fed with peanut. Rice, wheat, maize, millet, peanut and sunflower seed were offered to rats for multiple-feed test.

All grains except millet and sunflower seed were offered in coarse form with particle size 2.5-3.5 mm. Millet and sunflower seed were offered as whole which measured 0.8-2.00 mm and 8.0-10.0 mm, respectively. The weight of the each rat was recorded before the start of each test. Each cereal, weighing 30 g was offered daily in feeding cups.

The left over grain and spillage were collected after 24 h intervals, by placing clothing paper underneath the cages and weighed to calculate mean daily consumption with an accuracy of 0.1g. Each day fresh bait was offered and left over was discarded due to urine and faecal contamination by the rats. The position of feeding cups was changed daily to avoid any place preference trend. Each test lasted for 7 consecutive days. The rats were reused in the tests and re-arranged in the subsequent groups so that previous test food exposure is evenly distributed among new groups. To further carry over effects five days rest period was maintained between various tests during which animals were fed on laboratory diet. Spillage was collected daily and left-over was weighed to calculate the daily consumption.

Statistical analysis

Mean daily intake was converted in to gm consumed/kg body weight/day and percent consumption in choice tests was compared. Mean food consumption data was analyzed by one-way analysis of variance (ANOVA) for significant effects. The individual mean comparisons were made using least significant difference (LSD) test. Under paired choice tests students 't' test was applied to analyze the mean consumption between different cereals. The percentage preference values were calculated by dividing the test food by the total food offered consumption and then multiplying by 100.

Table I.- Average daily consumption and percentage preference of short-tailed mole rat (*Nesokia indica)* among various food items under no-choice tests.

Feed item	No. of animals *(n)*	Mean body weight ± SE *(g)*	Mean daily consumption ± SE *(g/kg body wt)*[*, **]
Rice	10	196.77±33.99	47.75±5.73[a]
Maize	10	197.46±33.99	35.28±2.98[b]
Wheat	10	255.52±33.09	30.55±3.04[b]
Peanut	10	266.48±33.39	27.95±2.12[b]
Millet	10	325.71±36.48	26.58±1.93[b]
Sunflower seed	10	236.22±33.84	26.68±4.80[b]

[*]Significant difference of intake (P<0.05) by ANOVA,
[**]Mean followed by the same letter(s) are not significantly different at 5% level by LSD test.

RESULTS

No-choice test

Single feed test

Under no-choice test, the offered cereal baits *i.e.* wheat, rice, maize, millet, peanut and sunflower seed were provided separately to rats. Results of the mean daily consumption of different grains showed that rice was the most preferred food item, followed by maize, wheat, peanut, millet and sunflower seed (Table I). The analysis of variance (ANOVA) value suggested that difference among the consumption of different food items was significant ($F_{5,14}$=3.97; P<0.05). Mean separation by least significant difference (LSD) test revealed that rice was

Table II.- Average daily intake and percentage preference of *Nesokia indica* under paired choice tests.

Feed combinations		Mean body weight ± SE (g)	Average daily intake ± SE (g/kg body wt)		Percent preference	
1	2	(n=10)	1	2	1	2
Rice vs.	Wheat	277.52±33.89	20.71±3.84	16.58±2.61	55.54	44.46
Rice vs.	Maize	290.00±34.25	21.35±5.89	17.05±2.64	55.82	44.18
Rice vs.	Millet	328.66±31.89	28.34±2.73	9.66±1.19*	74.58	24.42
Rice vs.	Peanut	321.28±34.32	21.34±2.68	8.14±1.37*	72.39	27.61
Rice vs.	Sunflower seed	290.00±34.25	22.25±2.88	10.91±2.45	67.10	32.90
Wheat vs.	Maize	334.62±33.49	19.68±3.01	15.60±2.18	55.78	44.22
Wheat vs.	Millet	328.73±30.55	22.15±3.33	18.89±1.80	53.97	46.23
Wheat vs.	Peanut	337.71±32.28	20.58±2.04	8.32±1.44*	71.21	28.79
Wheat vs.	Sunflower seed	335.71±34.10	24.11±1.91	12.75±2.03*	65.41	34.59
Maize vs.	Peanut	341.04±31.52	16.78±1.06	10.04±1.26*	62.57	37.43
Maize vs.	Millet	325.77±35.63	11.98±1.41	20.80±3.45*	36.55	63.45
Maize vs.	Sunflower seed	334.92±32.18	24.83±1.28	9.54±0.84*	72.24	27.76
Millet vs.	Sunflower seed	326.00±34.19	17.54±1.21	11.69±1.59*	60.00	40.00
Millet vs.	Peanut	330.31±30.38	25.89±2.90	12.62±1.22*	67.23	32.77
Sunflower seed vs.	Peanut	341.20±30.93	8.06±0.76	10.94±1.40	42.42	57.58

*P<0.05

Table III.- Average daily consumption (g/kg body weight) of short-tailed mole rat (*Nesokia indica*) on various food items in multiple-feed choice test.

Feed items	No. of animals *(n)*	Mean body weight of rats ± SE *(g)*	Mean daily consumption ± SE *(g/kg body wt.)* [*, **]	Percent preference
Rice	10	308.13±26.46	18.83±2.26[a]	35.47
Wheat			13.92±2.71[b]	26.22
Peanut			11.22±1.13[b]	21.15
Maize			5.82±1.13[c]	10.96
Millet			3.08±0.89[cd]	5.80
Sunflower seed			0.21±0.68[d]	0.40

[*]Significant difference of intake (P<0.05) by ANOVA

[**]Means followed by the same letter(s) are not significantly different at the 5% level of probability using LSD test.

consumed significantly, while non-significant difference was recorded among wheat, maize, millet, peanut and sunflower seed.

Choice test

Two feed test

The test was conducted to compare the consumption trend between two cereal baits in fifteen various combinations (Table II). In rice-wheat combination, non-significant difference in consumption was found (P>0.05). Likewise, equal trend of preference was recorded with rice (55.54%) and wheat (44.46%).

In rice-maize combination, non-significant difference in cereal intake was recorded (P>0.05). The preference trend was titled towards rice (55.82%) in comparison to preference for maize (44.18%).

In case of rice-millet combination, significant difference was found (t: 5.8621, df, 14; P<0.005). Rice preference was recorded three times higher over millet *i.e.* 74.58% and 24.42%, respectively. Likewise, significant difference was found in rice-peanut combination (t: 4.09, df 14; P<0.05), while rice-sunflower combination remained non-significant.

Under four different combinations of wheat with various offered cereal baits *i.e.* maize, millet, peanut and sunflower seed, significant difference in consumption was noted in wheat vs peanut

combination (t: 4.50, df 14; P<0.05 and t: 3.8, df 14; P<0.05). While non-significant difference was recorded in rest of the combinations. Significant difference was noted under wheat vs. sunflower seed, maize vs. peanut and maize vs. millet combinations (P<0.05). Percentage preference of wheat remained on the higher side in comparison to sun flower seed, peanut and millet. In wheat vs. sunflower seed combination wheat was consumed by two- fold (65.41%) over sunflower (34.59%). Similar trend was observed in maize vs. peanut combination *i.e.* maize (62.57%), while reverse trend was observed in maize vs. millet combinations (millet, 63.45% and maize, 36.55%). The preference of maize was on the higher side (72.24%), in comparison to sunflower seed (27.76%) in maize vs. sunflower seed combination.

In case of two combinations of millet in comparison to sunflower seed and peanut, significant difference of intake was noted as revealed by 't' test in millet vs peanut (t: 3.85, df 14; P<0.05) and millet vs sunflower seed (t: 2.731, df 14; P<0.05). In both combinations, millet intake remained double over others. Millet bait was consumed by 60.00% in comparison to sun flower seed (39.99%). Similarly in case of millet vs peanut, millet intake was recorded 47.33% in reference to peanut (32.77%). In sunflower seed and peanut combination, non-significant difference of intake was noted. The preference of rats for both grains remained almost similar (sun flower, 42.42% and peanut, 57.58%).

Multiple choice test

Under multiple-choice test, all six offered cereals were exposed to rats in the same cage for seven days. The results showed significant difference (F=18.25; df 5.48; P<0.05) by ANOVA. (Table III). Rice grain remained the most preferred grain (35.47%) followed by wheat (26.22%), peanut (21.15%), maize (10.96%) and millet (5.80%). The sunflower seed was the least sampled food (0.40%). The result of LSD test showed significant difference of rice grain in comparison to others. Likewise, wheat and peanut were consumed significant by more over maize, millet and sunflower. The consumption of maize and millet remained significantly higher over sunflower seed, however, mean consumption value between wheat-peanut and maize-millet remained non-significant (P>0.05). Results of multiple-choice test confirmed those of no-choice (single choice) and paired-choice test in which rice grain emerged the most preferred cereal followed by wheat and peanut.

DISCUSSION

The study showed that rice grain consistently appeared as the most preferred food item under all laboratory conducted tests against *N. indica.* Wheat remained the second most frequently consumed food grain and its consumption remained significantly lower than rice in all the combinations.

Most of the field rodents are selective in choosing their food, when different natural foods are available (Prakash, 1969). Food preferences are influenced by calorigenic value (Mathur *et al.*, 1992) and palatability of the food items (Young, 1946). Daily requirement of different nutrients like fats, protein and carbohydrates may also affect the feeding preference of the specific animal and/or population of an area. (Stenseth, 1977). The preference of the food may depend on the acclimatization of the animal or population to the frequently available food in the area (Mushtaq *et al.*, 2009). *N. indica* showed no sign of grain preference due to its being nearer to the food station. However, many rat species had selective preference for certain grains. According to Shafi *et al.* (1988) there was no influence of specific locus as long as the food are separated equidistant from the animal. Food preference criteria in field rodents may be different than those of commensal rats. In case of commensal rats, the preferred foods are almost always available and known to rats, but for field rats *e.g., B. bengalensis* and *N. indica,* the choice of preference depends on the season and animal may have to switch over to others/less preferred type of food, when the preferred food becomes scare. Sometimes, the food is selected more on the basis of availability than that of palatability, energy or protein contents (Pervez, 2007). However, for the field rats, *B. bengalensis* and *N. indica* being extensive burrower (especially *N. indica)* they select the food to compensate the daily energy requirement (Clapperson, 2006). According to Spillet (1968)

field rodents not always select foods in its preferential nature but observing other individuals while foraging, and may also play a significant part in food sampling.

The preference of cracked form over whole form of grain in rats is well documented (Jackson, 1965). The definite reason for the preference of cracked form of grains is difficult to interpret; however, it has the practical value for *N. indica* control as it can adhere a higher quantity of the rodenticides. Field studies related to *N. indica* with different poisons are required to test the efficacy of selected grains as effective bait base.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. Mubarik Ahmed, Director General, SARC for providing technical support during the study. The research was conducted through financial support under ALP/USAID Project, which is greatly acknowledged. The assistance rendered by field team of VPCI/SARC to collect live rats is highly appreciated.

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(Received 4 April 2014, revised 2 May 2015)