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Effect of texture on the food preferences of bait-shy wild rats (*Rattus rattus* L.) II.

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Abstract. Black rats, *Rattus rattus* L., poisoned with 0·02% zinc phosphide in whole lentil (*Lens esculenta*) or green gram (*Phaseolus aureus*) did not accept their whole grains again (bait-shyness). No similar aversion was, however, shown to husked grains of lentil or green gram.

Apparently alternative textural states of the two pulses have distinctive tastes, and hence poisoning in one form (whole grains) does not affect the preference for the other form (husked grains). It is thus possible to avoid 'bait-shyness' by using whole and then husked grains of such pulses for poisoning this pest.

Keywords. *Rattus rattus*; food preferences; textural effects; black rats.

1. Introduction

The black rat is one among several species of wild rats, which rapidly learn to avoid eating a poisonous mixture (poison shyness; Barnett *et al* 1975) and the particular foods used in it as base (bait-shyness). Thus rats surviving a poisoning campign, may not accept the same poison or bait again (Barnett 1975). The study of this behaviour is important in our efforts to eradicate this pest (Chitty 1954).

The baits ordinarily used, cereals or pulses, are available in several forms—whole grains, husked grains, husked and cracked grains and flours in various states of division. There is evidence that cereals have distinctive tastes as grain and flour, and poisoning in cereal flours does not affect the preference of bait-shy rats for respective whole grains (Bharadwaj and Khan, in press).

In our present study, such alteration of taste with texture was examined in the case of two pulses, lentil (*Lens esculenta* Moench) and green gram (*Phaseolus aureus* Roxb.). The rats were poisoned with zinc phosphide in moist whole grains, and then their responses to moist whole and husked forms of the two pulses have been measured.

2. Materials and Methods

Bisexual group of black rats, *R. rattus*, trapped from Aligarh city, were housed in four wire-mesh cages, $1{\cdot}12 \times 1{\cdot}0 \times 0{\cdot}32$ m, with empty tins and straw for nesting. Water was provided *ad lib.*

When the experiments started the first experimental group ($N=6$) weighed 115·0 ±S.E. 14·3g (range: 80–160g), and the control group (N=5) 117·0±S.E. 8·1g

(100–140g). In experiment 2, the mean weight of the experimental colony (N=6) was 100·0±S.E. 8·8g (82–130g), and the control (N=5) 96·0±S.E. 4·3g (82–105g).

Commercial varieties of lentil (*L. esculenta*), green gram (*P. aureus*) and black were gram (*P. mungo* Roxb.) in two forms viz. whole grains and husked, cracked grains, were used as test foods.

Weighed amounts of food soaked in water for 24 hr, drained on wiregauze for 2 hr and weighed again, were presented to the rat colonies. The residue, including spillage, was dried at 80° C for 24 hr and then weighed (Rw). Equivalent amounts of pulses, as controls, were similarly soaked, drained, weighed and then dried for 24 hr and weighed again (Cw). Consumption of each pulse in terms of dry weight was calculated by subtracting from the weight of control the weight of residue each day. The weight of a pulse was nearly doubled on soaking, but there was little variation in dry weights.

3. Experimental procedure

In experiment 1, the rats were offered the choice between husked lentil and black gram for five days and in continuation whole lentil and black gram also for five days. Whole lentil mixed with zinc phosphide (0·02 %, dry weight) and harmless black gram were given on the following six days. In the next 10 days, preference for husked lentil, husked black gram and whole lentil, whole black gram was tested again, each for five days. Control rats received the same foods, without the poison.

The same procedure was followed in experiment 2, except that the choice was between green gram and black gram. Treatment was given in whole green gram. Controls were also run, as in experiment 1.

The choice shown by the experimental rats for each form of the two pulses before and after treatment was compared to choice shown for equivalent forms by the controls. Student's ' t ' test (Bailey 1959) was used for testing the significance of preferences observed.

4. Results

Some of the rats died during treatment, 160g ♀ *a* 150g ♀ in experiment 1 and 130g ♀ *a* 81g ♀ in experiment 2, but the experiments were continued with survivors. The results are given in table 1. Similar results obtained from other colonies which were greatly decimated by the poison, are not reported here.

In experiment 1, before the poison was presented, husked or whole lentil was preferred to husked or whole black gram (table 1). Similarly, husked or whole green gram was selected when compared to the two forms of black gram (table 1). Controls also preferred lentil to black gram (mean daily intake; 211·6±11·7g husked lentil, 104·0±2·1g husked black gram; 229·5±11·7g whole lentil, 85·8±7·3g whole black gram) and green gram to black gram (mean daily intake: 211·6±1·6g husked green gram, 103·3±6·1g husked black gram; 235·6±14·4g whole green gram, 82·4±9·0g whole black gram).

The whole lentil and green gram were rejected when mixed with zinc phosphide but the consumption of poisonous mixtures was reduced only gradually and that of harm-

Table 1. Consumption by two groups of rats of husked and whole pulses before and after treatment with zinc phosphide in whole pulses.

Expt. No.	Length of test (Days)	Foods offered	Mean daily consumption g/day ± S.E.	% Total consumption
1	5	Husked lentil; Husked black gram	198·0 ± 5·0; 60·5 ± 3·7	77; 23
	5	Whole lentil; whole black gram	213·3 ± 1·7; 109·6 ± 3·2	66; 34
	6	Whole lentil + Poison; whole black gram	45·4 ± 33·0; 119·8 ± 7·5	27; 73
	5	Husked lentil; Husked black gram	113·5 ± 15·0; 22·3 ± 5·4	84; 16
	5	Whole lentil; whole black gram	20·5 ± 3·7; 66·0 ± 5·0	23; 77
2	5	Husked green gram; Husked black gram	201·5 ± 6·0; 66·5 ± 6·4	76; 24
	5	Whole green gram; Whole black gram	211·6 ± 1·6; 107·6 ± 3·7	67; 33
	6	Whole green gram + Poison; whole black gram	42·0 ± 31·2; 124·4 ± 9·3	24; 76
	5	Husked green gram; Husked black gram	114·3 ± 13·3; 27·3 ± 3·7	81; 19
	5	Whole green gram; Whole black gram	14·5 ± 0·71; 116·0 ± 14·0	10; 90

less black gram increased simultaneously (table 1). Thus, during poison treatment the choice in experimental groups became obverse to that observed for harmless equivalents in controls (mean daily intake: 239·5±4·5g whole lentil, 59·0±5·7g whole black gram; 236·0±4·0g whole green gram, 70·5±12·5g whole black gram).

When the pulses were presented again after treatment, but without poison, the whole lentil was consistently avoided in experiment 1 and similarly the whole green gram in experiment 2; and the whole black gram was mainly eaten in both experiments (table 1). In controls, the rats persisted with eating more lentil or green gram rather than black gram (mean daily intake: 215·0±15·1g whole lentil, 13·0±2·4g black gram; 137·5±7·5g whole green gram, 15·0±1·0g black gram). Thus rats of both experiments 1 and 2 did not again prefer the foods in which they were poisoned.

In both experiments, however, husked lentil and husked green gram continued to be preferred to husked black gram (table 1), much like the controls which also showed the same preference as before (mean daily intake: 140·0±24·5g husked lentil, 18·6±6·0g husked black gram; 161·6±20·0g husked green gram, 30·6g husked black gram). This was in contrast to the avoidance response shown by the experimental groups to whole lentil or green gram after treatment (table 1).

5. Discussion

Exposure to poisoned lentil or green gram led to some deaths, clearly due to its ingestion in large amounts. Consumption of poisoned foods was then reduced by the survivors, though it was not stopped completely (table 1). The avoidance obviously followed the development of 'poison-shyness' to zinc phosphide, while continued sampling of its mixtures may have been the result of the delayed action of poison (Barnett *et al* 1975). Zinc phosphide is a relatively slow-acting poison and the response induced by it is not comparable to that obtained with compounds which act quickly, like apomorphine sulfate, and bring about total avoidance in similar situations (Garcia *et al*, 1974).

Following treatment, the rats also became ' bait-shy ', or averse to eating the particular foods in which they were poisoned, whole lentil in experiment 1 and whole green gram in experiment 2 (table 1). Several species of rodents, including the gerbils *M. hurrianae* and *T. indica* (Prakash and Jain 1971) similarly respond to foods treated with zinc phosphide. Our rats, however, did not avoid the alternative forms of the same foods, i.e. husked lentil in experiment 1 and husked green gram in experiment 2 (table 1).

If taste was the basis for such avoidance (Barnett *et al* 1975; Garcia *et al* 1974) then the taste of whole lentil or green gram was obviously distinct from that perceived in husked lentil or green gram. Thus two forms of the same pulse were treated as two different kinds of foods and poisoning in one form (whole grains), therefore, did not affect the preference of the rats to the other form (husked grain). Perhaps the outer seed structures (pericarp and testa) are responsible for such alteration of taste with texture in the case of whole grains which contained them as compared to husked grains, which are devoid of them (Khan 1974). Something very similar has also been observed in case of cereals (Bhardwaj and Khan, in press).

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