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Responses of roof rat, *Rattus rattus* L., to non-oily and oily foods after poisoning in oily foods

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Abstract. The rats, *Rattus rattus* L., rejected oily foods previously mixed with zinc phosphide; but cereal equivalents, or non-oily foods were avoided only partially. Groundnut oil, though of neutral flavour, also exerted thus some masking effect on the taste of cereal bases.

1. Introduction

Rattus rattus L. develop bait-shyness, or the avoidance of poisonous foods (Barnett 1975). The shyness appears for both poison and bait (Armour and Barnett 1950), which have to be changed in the field after every treatment (Barnett and Prakash 1975). Of the latter, mixtures of cereals and tasteless vegetable oils, e.g., of groundnut (*Arachis hypogea*), are widely used (Prakash 1976). Very little is, however, known about the choice of survivors, or bait-shy rats, to oily and non-oily foods. This was analysed by comparing the preferences of *R. rattus* for oily foods and plain cereal equivalents after poisoning in the former.

2. Materials and methods

2.1. *The rats*

Subjects were wild-caught stock; fed and housed as described earlier (Bhardwaj and Khan 1978). They were weighed and grouped into bisexual colonies; pregnant females and juveniles were excluded. The experiments conducted are termed I (for experiment 1) and II (for experiment 2), etc., throughout this paper. The colony selected for treatment had the mean weight of (i) 171·0 ± S.E. 10·82 g for I (N = 7), (ii) 150·12 ± S.E. 23·0 g for II (N = 3) and (iii) 123·71 ± S.E. 12·75 g for III (N = 3). The control colonies had mean weights of (i) 170·33 ± S.E. 7·54 g (N = 7), (ii) 107·0 ± S.E. 9·31 g (N = 4) and (iii) 110·11 ± S.E. 26·43 g (N = 3) respectively. Replicates were also run.

2.2. *Test foods*

Unextracted flours of millet (*Pennisetum typhoides*), maize (*Zea mays*) and wheat (*Triticum aestivum*) were used as test foods. Groundnut oil was used in concentrations of 5%; and zinc phosphide, as poison at the rate of 0·04%. The weighed foods, two at a time, were given in metal containers; the residue, including spillage, was weighed the next day.

2.3. *Experimental procedure*

In I, wheat flour was compared to millet flour and then to millet flour and oil in two consecutive tests of 8 days each. The rats were poisoned in oily food for 11 days. After this, oily and non-oily foods were again offered. In the former, maize flour and oil was also offered. The same procedure was followed in II and III except the choice between wheat flour and millet flour or millet flour and oil for (II) and maize flour or maize flour and oil for (III) was observed for 4 days each. Poison was given only for 8 days. Unlike I, no new oily food was offered after poisoning. Schedules for controls were similar, but they were not given any poison. Intake was recorded daily for 43 days (I) or 24 days (II and III).

2.4. *Statistical analysis*

Significance of preferences observed was tested by paired t tests (Bailey 1959); and of changes in it by Mann–Whitney U test (Gibbons 1971).

3. Results

Some rats died in I, but no deaths were observed in II and III. Results from only one colony of each experiment are, however, included in table 1.

3.1. *Selection of test foods (non-oily foods)*

Both millet and maize flours were preferred to wheat flour ($P < 0·05$; table 1).

Oily foods : Oily foods were similarly preferred ($P < 0·05$); millet or maize flour and oil were thus mainly eaten (table 1).

A similar choice was observed in the controls (table 1).

3.2. *Effect of poisoning in oily foods*

The consumption of poisonous millet or maize flour and oil declined on the first day. The avoidance became more obvious on the following days (U tests; $P < 0·05$). The rats changed over to eating harmless wheat flour, or the choice was reversed (table 1).

3.3. *Preference observed after poisoning*

Non-oily foods : Millet flour in I and II, and maize flour in III, were again preferred to wheat flour, except on the day after poisoning ($P < 0·05$). Unlike in controls, however, both the cereals were now consumed in smaller amounts compared to that observed before poisoning (table 1). Wheat flour was consumed in larger amounts (table 1). Non-oily foods were avoided, but only partially.

Table 1. Consumption of foods (means ± S.E.) offered in rat colonies.

Expt. No.	Length of test (days)	Foods offered	Mean consumption g/day ± SE	% Total consumption
1	8	Millet flour	72·0 ± 7·8	70
		Wheat flour	30·3 ± 4·5	30
	8	Millet flour + Oil	71·7 ± 6·1	72
		Wheat flour	27·2 ± 5·4	28
	11	Millet flour + Oil + poison	11·2 ± 4·6	11
		Wheat flour	93·7 ± 1·4	89
	8	Millet flour	53·8 ± 1·4	52
		Wheat flour	49·7 ± 4·2	48
	4	Maize flour + Oil	67·7 ± 7·8	66
		Wheat flour	34·9 ± 1·3	34
	4	Millet flour + Oil	41·7 ± 6·2	40
		Wheat flour	58·9 ± 7·2	60
Control	8	Millet flour	50·0 ± 9·0	82
		Wheat flour	11·0 ± 5·0	18
	19	Millet flour + Oil	86·3 ± 2·1	73
		Wheat flour	31·6 ± 1·8	27
	8	Millet flour	93·5 ± 6·1	69
		Wheat flour	41·3 ± 3·3	31
	8	Millet flour + Oil	72·0 ± 1·2	75
		Wheat flour	24·0 ± 6·0	25
2	4	Millet flour	32·2 ± 1·3	89
		Wheat flour	4·0 ± 1·5	11
	4	Millet flour + Oil	26·5 ± 0·8	90
		Wheat flour	3·0 ± 0·7	10
	8	Millet flour + Oil + poison	5·5 ± 4·5	25
		Wheat flour	15·0 ± 2·1	75
	4	Millet flour	15·7 ± 3·0	60
		Wheat flour	10·5 ± 0·9	40
	4	Millet flour + Oil	11·0 ± 1·2	36
		Wheat flour	20·0 ± 0·8	64
Control	4	Millet flour	33·0 ± 1·3	92
		Wheat flour	2·0 ± 1·1	8
	12	Millet flour + Oil	26·5 + 1·5	84
		Wheat flour	5·0 ± 1·2	16
	4	Millet flour	23·5 ± 0·6	78
		Wheat flour	6·7 ± 1·3	22
	4	Millet flour + Oil	31·5 ± 1·8	87
		Wheat flour	4·5 ± 0·5	13

Table 1 (*contd*).

Expt. No.	Length of test (days)	Foods offered	Mean consumption g/day ± SE	% Total consumption
3	4	Maize flour	31·2 ± 4·7	74
		Wheat flour	11·2 ± 2·5	26
	4	Maize flour + oil	30·5 ± 1·5	85
		Wheat flour	5·5 ± 0·6	15
	8	Maize flour + oil + poison	5·3 ± 2·5	21
		Wheat flour	19·3 ± 1·2	79
	4	Maize flour	22·0 ± 4·0	53
		Wheat flour	19·5 ± 2·1	47
	4	Maize flour + oil	15·5 ± 0·6	36
		Wheat flour	28·0 ± 1·2	64
Control	4	Maize flour	24·5 ± 1·3	68
		Wheat flour	11·7 ± 1·1	32
	12	Maize flour + oil	27·5 ± 1·5	72
		Wheat flour	10·7 ± 0·5	28
	4	Maize flour	26·5 ± 1·2	71
		Wheat flour	10·3 ± 0·51	29
	4	Maize flour + oil	26·0 ± 1·8	75
		Wheat flour	8·7 ± 0·7	25

Oil foods : In the following tests, however, the rats showed clear bait-shyness, rejecting the foods in which they had ingested poison, namely, millet flour and oil in I and II and maize flour and oil in III (table 1). Earlier the same foods had been greatly favoured, as they still were in the controls (table 1).

Although millet flour and oil was rejected in I, maize flour and oil was much preferred to wheat flour ($P < 0{\cdot}05$: table 1).

4. Discussion

Dry or moist bait mixed with 0·04% zinc phosphide are avoided only gradually by the rats, *R. rattus* (Bhardwaj 1976; Bhardwaj and Khan 1978). Avoidance developed rapidly, however, when this poison was given in oily foods (table 1). Perhaps zinc phosphide was easily ingested and took immediate effect when given in these baits because of the adhesiveness of oil. Thus, the behaviour (poison-shyness) is also influenced by the nature of bait employed.

Poisoning with oil also affected the responses to baits offered subsequently. Shyness developed for oily mixtures (bait-shyness) was not exactly broadened to corresponding cereal bases; and both millet and maize flours were avoided only partially by the bait-shy rats (table 1). It would seem that such discrimina-

tions between oily and non-oily foods were made on the basis of their distinctive tastes (Barnett *et al* 1975). It seems, however, more likely that there is only a difference in the strength of taste perceived in the alternative forms.

Thus, groundnut oil has no flavour and at best a neutral taste (Barnett 1969). This is also confirmed by the results of I as maize flour and oil (and not millet flour and oil) was preferred by the rats after poisoning in millet flour and oil (table 1). However, cereal flours have strong and distinctive tastes (Khan 1974). In human beings, however, taste effectiveness of sweet substances is reduced in the presence of non-sweet stimuli (Cameron 1947). Something similar may have occurred in our experiments: and the neutral groundnut oil exerted some masking effect on the taste of cereal bases.

It is, therefore, obvious that bait-shyness developed by *R. rattus* can be reduced, but not eliminated, by poisoning them in cereals with groundnut oil and then in the same baits without it.

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