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A sensitive period for the acquisition of food preferences in the Indian field mouse *Mus booduga* (Gray)

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Abstract. The effect of exposure to particular cereals during infancy on adult food selection, and the sensitive period of acquisition of such food preferences, were studied in the Indian field mouse, *Mus booduga* Gray. Preliminary tests indicated an influence of early exposed diet on adult food selection. Further tests suggested that there is a sensitive period (4-6 days after birth) during which long lasting diet preferences are established in this wild mouse.

Keywords. Early experience; food selection; sensitive period; *Mus booduga* Gray; Indian field mouse.

1. Introduction

Foods ingested early in life have a profound influence on adult diet selection in the snapping turtle, *Chelydra serpentina* (Burghardt and Hess 1966), the diamond terrapin, *Malaclemys centrata* (Allen and Littleford 1955) and sheep (Arnold and Maller 1977). Garter snakes displayed enhanced responsivity to the odour of infant experienced diet, although such preferences were easily alterable (Fuchs and Burghardt 1971). The evidence for food imprinting in birds is overwhelming (Hess 1964; Burghardt 1969; Capretta 1969; Hogan 1977). It is difficult to demonstrate the primacy effect of such olfactory or food experience in rodents. Earlier attempts by Warren and Pfaffmann (1959), Krishnakumari (1973) and Bronson (1966) failed to show any effect of foods ingested during post weaning on adult food selection in rats and guinea pigs although recent work of Capretta and Rawls (1974), Bronstein and Crockett (1976), Cornwell (1976), Porter and Etscorn (1976) and Sridhara (1978) showed that food odour and flavours experienced very early in life *i.e.* during preweaning or during the first post natal week of life result in temporary preference towards such odours and flavours.

In the present study tests were carried out to determine the effect of exposure to cereals during preweaning, on diet selection during adulthood and the timing of any sensitive period that there may be for the development of food preferences in the Indian field mouse, *Mus booduga* Gray. The species is a widely distributed pest of agricultural crops causing considerable damage (Barnett and Prakash 1975). In formulating effective baits for its control, it is helpful to consider factors influencing its feeding behaviour, hence this study.

2. Materials and methods

The subjects were caught by digging burrows in cultivated fields. Pairs of adult mice

were maintained in laboratory cages (30 × 25 × 30 cm) made of sheets and mesh of galvanized iron, with two nest boxes (9 × 12 × 9 cm), one at each end containing hay and cottonwool for bedding. The animals were maintained on a 12:12 LD schedule, with the light period beginning at 0600 hours each day. The room temperature was 25 + 2°C. During pregnancy and upto the birth of the litter, females were fed *ad lib* rat and mouse feed (Hindustan Lever, India), a standard unattractive lab chow and water. The gestation and weaning periods are 21 and 28 days respectively.

The first experiment was designed to detect the influence of food ingested early in life on diet selection in adulthood. The naive litters of three different mothers were exposed to three different foods, namely rice, ragi and wheat until weaning. During the following fortnight, the three experimental batches received rat and mouse food. On the sixteenth day, the rice-fed group was exposed to a choice of rice versus jowar, the ragi-fed batch were given ragi and jowar, and the wheat-fed batch were given wheat and jowar. After 24 hr, the relative consumption of the two choice foods was measured to the nearest 0.1 g. Following the preference test, the three experimental groups were fed on commercial rat and mouse feed for 15 consecutive days. A second choice test, identical to the first, was conducted at the end of this period.

The aim of the second experiment was to detect if any, the sensitive period for food preference acquisition. Naive litters from at least two mothers were used for each batch. The experiment involved exposing litters of different age groups to a specific food for a fixed period of 3 days at each age. Accordingly a total of seven age groups, starting at ages 1 day, 4 days, 7 days, 10 days, 13 days, 16 days and 19 days (table 1) were exposed to a rice-ragi mixture (50:50 by weight) for 3 days and then maintained on commercial rat feed for the next 15 days. Apart from these one more batch of one-day old litters was exposed to rice-ragi mixture for a day. The above groups were then given a test involving choice between the rice-ragi mixture and jowar. The intake of the two foods was measured to the nearest 0.1 g 24 hr later. The choice tests were repeated a fortnight and a month later. The subjects were given commercial rat and mouse feed before and after food conditioning and in the interval between the choice tests; water was available *ad lib* throughout the study period.

Table 1. Summary of the design of experiment 2.

	Batch No.							
	1	2	3	4	5	6	7	8
No. of animals in batch	9	8	9	7	8	8	10	8
Age of litter at initial exposure to rice-ragi mix. (days after birth)	1	1	4	7	10	13	16	19
Choice test 1*	15 days after initial exposure							
Choice test 2*	32 days after initial exposure							
Choice test 3*	48 days after initial exposure							

* rice-ragi mixture versus jowar

The cereal consumptions in experiment 1 were compared statistically using student t tests. In the second experiment, the percentage by weight of the food eaten that consisted of the rice-ragi mixture were calculated and subjected to an overall analysis of variance (Snedecor and Cochran 1968). In addition, an ANOVA was also carried out for comparison of the eight age groups in each of the three choice tests.

3. Results

The mice of the three experimental groups of test one preferred rice, ragi and wheat, the cereals to which they had respectively been pre-exposed, to the novel jowar ($P < 0.001$, table 2). A similar preference was observed during the second choice test with the earlier exposed cereals being consumed much more than the more recently experienced jowar ($P < 0.001$, table 2).

Significant variation was observed in the intake of rice-ragi mixture and jowar between the eight age groups ($F = 41.12$, $df = 7$, $P < 0.01$; table 3), between the three tests ($F = 72.96$, $df = 2$, $P < 0.01$), and for the age/test interaction ($F = 10.83$, $df = 14$, $P < 0.001$). The influence of training age on adult diet choice was confirmed by a separate one way analysis of variance across the eight age categories for each of the choice tests (test 1: $F = 36.65$, $df = 7$, $P < 0.01$; test 2: $F = 10.58$, $df = 7$, $P < 0.01$; test 3: $F = 16.76$, $df = 7$, $P < 0.01$). Early experience influences later food selection only in the groups trained on days 1-3, 4-6 and 7-9 in the first test (CD value = 14.32 at $P < 0.01$), in the mice trained on days 1-3 and 4-6 in the second test (CD value = 13.47 at $P > 0.05$) and in the 10-12 days (CD value = 20.07 at $P < 0.01$) and 4-6 days (CD value = 10.46 at $P > 0.05$) experienced animals in the third test. The persistent preference exhibited by mice exposed at days 4-6 in all the three tests towards the cereal mixture indicates this age to be more sensitive for the establishment of food preferences in *M. booduga*.

4. Discussion

The first series of experiments in the present study establish that foods experienced prior to weaning influence the adult diet choice in *M. booduga* as seen by preferential consumption of such food *viz.* rice, ragi and wheat compared to a novel food, jowar (table 1). The effect of foods exposed during pre-weaning when for the most part pups do not ingest them is not difficult to explain. After a series of experiments

Table 2. Consumption of familiar and novel foods by *M. booduga* in choice tests.

Batch (N)	Rice I(4)	Ragi II(5)	Wheat III(4)
First choice test			
Earlier ingested food	6.73±0.21	5.96±0.48	6.38±0.15
Jowar (novel)	0.86±0.07	1.39±0.11	1.67±0.21
$P <$	0.001	0.001	0.001
Second choice test			
Earlier ingested food	6.54±0.32	6.17±0.25	7.03±0.46
Jowar (novel)	2.01±0.44	1.88±0.31	1.38±0.14
$P <$	0.001	0.001	0.001

Capretta and Rawls (1974) concluded that consumption of garlic food by mothers during nursing resulted in a slightly increased preference towards garlic than actual consumption of garlic solution by pups following weaning, when tested later. Studies of Galef (1977) indicated that food preferences of rats are acquired socially and through the mother's milk. According to them mother's milk contains gustatory cues which reflect the flavour of her diet. Ingestion of such milk helps the pups to identify and prefer the food of the mother during and after weaning. Food identification is also made easy by residual olfactory cues left by the mothers at the feeding site and finally the pups learn to feed on maternal food by simple social imitation of their mothers. As both mother and litter are exposed to the same food till weaning in the first series of experiments, the factors put forth by Galef (1977) may be responsible for selective ingestion of experienced cereals by the mice compared to the novel jowar.

Hess (1962) described the period prior to 3-5 days age of chicks as the critical/sensitive period when food experiences are most likely to influence adult food choice. Similarly in the European polecat, *Putorius putorius*. the prey smell serving as a sign stimulus for recognising the prey is reported to be learnt during the

Table 3. Comparative intake of earlier experienced and new food at different ages by *M. booduga*.

Batch	I choice test			II choice test			III choice test		
	age at I test	mix. intake	jow. intake	age at II test	mix. intake	jow. intake	age at III test	mix. intake	jow. intake
1.	17 days	3.28 ± 0.55	3.78 ± 0.31	33 days	4.08 ± 0.33	3.44 ± 0.48	49 days	6.18 ± 0.15	5.25 ± 0.76
2.	19 days	8.55 ± 0.18	—	35 days	6.08 ± 0.36	1.96 ± 0.09	51 days	6.00 ± 0.19	4.31 ± 0.87
3.	22 days	7.06 ± 0.28	—	38 days	7.03 ± 0.59	1.28 ± 0.03	54 days	7.53 ± 0.81	2.86 ± 0.27
4.	25 days	7.94 ± 0.31	—	41 days	5.78 ± 0.28	2.19 ± 0.09	57 days	6.81 ± 0.25	3.85 ± 0.27
5.	28 days	6.85 ± 0.12	1.95 ± 0.14	44 days	7.33 ± 0.32	1.69 ± 0.26	61 days	11.80 ± 0.37	0.96 ± 0.18
6.	31 days	6.81 ± 0.53	2.08 ± 0.09	47 days	7.95 ± 0.64	3.27 ± 0.27	64 days	5.60 ± 0.96	4.81 ± 0.34
7.	34 days	9.81 ± 0.85	1.53 ± 0.16	51 days	5.23 ± 0.59	3.15 ± 0.46	67 days	6.75 ± 0.33	5.83 ± 0.29
8.	37 days	7.25 ± 0.61	2.03 ± 0.55	54 days	4.82 ± 0.73	3.56 ± 0.41	71 days	6.58 ± 0.32	5.91 ± 0.28

sensitive period of 2-3 months of age (Apfelbach 1973). Capretta and Rawls (1974) concluded that garlic experienced during nursing was more effective in forming adult garlic preference than similar experience imposed following weaning. The results of experiment two show that in *M. booduga* long-lasting food preferences are more effectively induced at the age of 4-6 days than at other ages. The food preference acquisition at this young age is possibly mediated through mother's milk theory of Galef (1977).

Leon *et al* (1977) explained the adult rat's preference for familiar odours and for food with which such odours are associated by proposing that young mammals exhibit a tendency to seek out familiar and hence safe cues, be they conspecific in a novel environment or familiar food in a test situation. They may thus avoid exposure to unfamiliar and aversive stimulation. Similar to this view is Rescorla's (1971) concept of reduced salience of the pre-exposed stimulus and the theory of 'learned safety' of Rozin and Kalat (1971). Early experience of a food during the sensitive period in the growth of *M. booduga* seems to have resulted in a preference for the familiar rice-ragi mixture, which had previously been experienced without harmful effect, rather than the novel jowar.

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