

EXPOSURE TO ONION TASTE IN MOTHER'S MILK LEADS TO
ENHANCED PREFERENCE FOR ONION DIET
AMONG WEANLING RATS*

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SUMMARY

Five mothers of 50 newborn rat pups were maintained on either standard lab chow or a diet composed of the same chow with onion powder added. Taste preference tests administered during weaning indicated that the pups whose mother was fed the onion chow showed a preference for onion diet, but that such preference dissipated across the five day testing period. A control group of pups who were exposed to any onion diet cues available through channels other than the mother's milk did not show a preference for onion diet. It was concluded that exposure to onion taste in mother's milk was responsible for an initial preference for onion diet.

A. INTRODUCTION

It has been established in several species that early exposure to certain foodstuffs can lead to enhanced preference for those foodstuffs in later life (6). Such effect has been demonstrated in snapping turtles (3), gulls (12), domestic chickens (4), cats and dogs (11), as well as other species. Attempts to demonstrate enhanced preferences during adulthood for foods eaten during weaning have been less successful when laboratory rats were used as Ss (1). Recent research with the laboratory rat has demonstrated that weanling rats show a preference for the diet which their mother or other nursing caretaker had consumed during the period she was nursing them; it has been concluded that such preferences were established on the basis of exposure to taste cues transmitted in the mother's milk (2, 5, 8, 9, 10).

B. METHOD

Ss were six female albino rats obtained from Charles River Breeding Laboratories and 50 pups born to five of the females. Litters were reduced to

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10 pups each on the day of birth, and pups were cross-fostered among the mothers on the following day. Each litter and mother was housed in individual maternity cages ($36 \times 31 \times 17$ cm) with water available at all times. Each mother and litter was randomly assigned to one of five conditions: Onion Incage (OI), Onion Outcage (OO), Onion Aunt (OA), Stock Outcage (SO), or Stock Incage (SI).

Two diets were prepared. The stock diet was powdered Agway Rat-Mouse Diet; the onion diet differed from the stock only in that it contained 5% by weight onion powder (McCormick brand). Onion was chosen because it is known to cross the lactating membrane and to impart onion flavor to the milk of mammals with onion in their diet (13). Mothers were removed from the litter cages to separate cages ($45 \times 24 \times 15$ cm) with water available for two 1½-hour feeding sessions daily. OI and OO mothers were fed the onion mixture; OA, SO, and SI mothers were fed the stock chow. The OI litter cage always had a food bowl with onion chow in it, while the SI litter cage always had stock food in a bowl; other litter cages had no bowl or food. During the daily feeding sessions the onion aunt was placed in the OA litter cage with the OA pups. The onion aunt was a nonlactating female who nevertheless showed maternal behaviors towards the pups; she was housed separately and was on the onion diet for the duration of the experiment.

On days 21, 23, and 25 of age the pups were tested for dietary preference. The testing apparatus consisted of a $28 \times 17 \times 13$ cm plastic cage with one feeding cup ($5 \times 3 \times 2.5$ cm crucible) attached at each end of the cage. Stock food was placed into one cup and onion food into the other. Each pup was individually placed into the testing apparatus with no food for three hours on day 20 to habituate to the apparatus; testing started the following day. Each pup was tested individually, being in the testing apparatus for 30 minutes on each of the three testing days. Location of the two food cups was switched, and the test apparatus rotated 30 degrees after each individual session. Each food cup was weighed before and after testing to determine amounts of the two diets eaten. Any spillage was returned to the appropriate cup prior to weighing. Weights were transformed into a preference score which expressed the amount of onion diet eaten as a percentage of total intake.

It was hypothesized that the greater the number of potential cues providing nursing pups with knowledge of their mother's diet, the greater would be the proportion of that diet chosen by the weanling pups. Outcage groups could have received cues from milk composition and mother's breath, body odor, feces, and food particles clinging to mother's fur. Incage groups would have in addition to all these cues direct exposure to the mother's diet. The OA group

was included as a control for all factors other than milk composition. Pups in the OA group were exposed to any onion diet cues available from breath, body odor, feces, or clinging food particles, but not to onion diet cues transmitted through the mother's milk. Accordingly, the hypothesized order of onion taste preference scores was $OI > OO > OA > SO > SI$.

C. RESULTS AND DISCUSSION

A summary of the results is presented in Table 1. Individual preference scores were transformed ($\arcsin \sqrt{\text{preference ratio}}$) to normalize the distribution prior to analysis of variance. Although no significant effect was indicated among the three testing days ($F = 2.20$; $df = 2, 90$; $p > .05$), both nursing groups ($F = 6.32$; $df = 4, 45$; $p < .01$) and the days \times groups interaction ($F = 3.49$; $df = 8, 90$; $p < .01$) provided significant effects. Tukey's test was used to compare all group means for each of the three testing days. The OO group differed significantly from all other groups on day 21; on day 23 both OO and OI groups ate a significantly higher percentage of onion diet than did the SO group ($p < .05$ in all cases). All other comparisons, including all comparisons on day 25, fell short of significance ($p > .05$).

The results indicate that exposure to onion diet through cues transmitted in mother's milk does enhance preference for that diet at weaning, but that such preference is very short in duration. Data from the OA group indicate that exposure to cues from sources other than mother's milk have little or no effect or that restricting such exposure to three hours daily eliminates any such effect. Whether the pups were allowed direct exposure to their mother's diet (incage *vs* outcage groups) also, somewhat surprisingly, appeared to have no consistent effect on dietary preferences.

Other researchers comparing two different brands of rat chow have also reported results indicating that the mother's diet during nursing had significant initial effects on the weaning pups' preferences, but that such

TABLE 1
MEAN PERCENTAGE OF ONION DIET CONSUMED

Group	Day		
	21	23	25
Onion Outcage	62	36	21
Onion Incage	24	44	10
Onion Aunt	5	25	14
Stock Incage	16	10	18
Stock Outcage	13	1	9

effects were short lived (2, 9). Capretta and Rawls (5) compared groups of pups who had had or had not pre- and/or postweaning exposure to garlic; again an initial difference among groups dissipated across 12 days of testing, but reappeared on a subsequent series of tests given a month later, suggesting that the effect of nursing experience may be longer lasting than otherwise suspected. I suspect that the short duration of the initial preferences established at weaning is largely a function of the method of behavioral testing typically used, where pups are tested individually in a two-choice situation. Feeding is a social event in the life of wild or colony-maintained rats. Galef and Clark (7) have demonstrated that pups will tend to establish preferences for foods which they have observed adult rats and their peers eating. It is likely that preferences established at weaning by cues transmitted in mother's milk would be of longer duration if social facilitation of feeding preferences were allowed to occur. For example, a litter of pups with an initial preference for onion diet might, if allowed to feed with littermates present in the choice situation, show a longer duration of preference for onion diet than would pups who had only individual feeding experiences. Further research is proposed to test this hypothesis.

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