

BRIEF COMMUNICATION

Food Deprivation-Induced Alcohol Ingestion in the Mouse: Calories Versus Primary Sensory Preference

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PALFAI, T. AND W. RECKHOW. *Food deprivation-induced alcohol ingestion in the mouse: calories versus primary sensory preference*. PHARMAC. BIOCHEM. BEHAV. 6(6) 709–712, 1977. — Random bred Swiss mice showed preference for water over 10% ethanol solution when unlimited food was available. When partially food deprived, the preference was reversed in 5 out of 8 animals. About half of the naive mice, however, ingested substantial amounts of this ethanol solution at the very first exposure when partially food deprived for 12 days. It is suggested that while the caloric value of ethanol is reinforcing, food deprivation might make the sensory effects of ethanol also reinforcing.

Alcohol Ethanol Preference Mice

WHEN GIVEN a choice between water and 10% alcohol, the laboratory rat and several strains of mice prefer water. Under certain conditions, however, this preference can be reversed. When the food intake of rats was restricted to 50% of ad lib baseline, the rats' intakes of 10% ethanol solution rose substantially while water intakes declined [5]. It has been suggested that food deprived rats ingest ethanol because it is a caloric source [1].

Studies on inbred mice [4] question the generality of this conclusion. There are no changes [4] in ethanol preference for three strains (BALB/C, DBA and C3H/2) when partially food deprived and an increase in one strain (C57BL). The latter strain, however, is known for high alcohol intake even when food is freely available [2,3]. The difference between the rat and mouse data, however, might be due to the inbred mouse strains. In the first experiment, therefore, the effect of partial food deprivation on alcohol preference in the random bred Swiss mouse was studied. In the second experiment, the effect of partial food deprivation on the initial reaction of naive mice to ethanol was examined. Our hypothesis was, that if food deprived mice ingest ethanol when first exposed to the solution, that is before the caloric effect of ethanol could reinforce the behavior, the sensory effects of ethanol might be considered as also reinforcing.

EXPERIMENT 1

Animals

Eight 90-day-old male White Swiss mice, obtained from

the ARS/Sprague Dawley Co., Millerton, NY, were used. The animals were housed individually in metal cages in a temperature (21°C) and humidity (50%) controlled colony room. A 12-hr dark-light cycle was in effect.

Procedure

The animals had access to water and 10% ethanol solution ad lib throughout the experiment; the positions of the fluid sources were switched at 24-hr intervals. Daily measurements of body weight, water and alcohol intakes were taken for the duration of the experiment. The intakes were measured to the nearest 1/10 of ml by means of graduated eudiometer tubes.

For the first 10 days, Purina Chow pellets were available ad lib. At this point, 4 of the animals were given 3 g food/day for 10 days. The 4 control mice continued to receive food ad lib. Following this period, all animals had access to unlimited food for an additional 10 days. In the last phase of the experiment all mice were placed on the partial food deprivation schedule for 30 days.

Results

The results are shown in Fig. 1. As can be seen during ad lib food, 7 of the 8 mice almost totally rejected the ethanol solution. By the eighth day of partial food deprivation, however, 3 out of the 4 experimental animals ingested substantial amounts of ethanol. When food was returned ad lib, one mouse continued to prefer the drug solution; the others returned to their pre-deprivation patterns of fluid

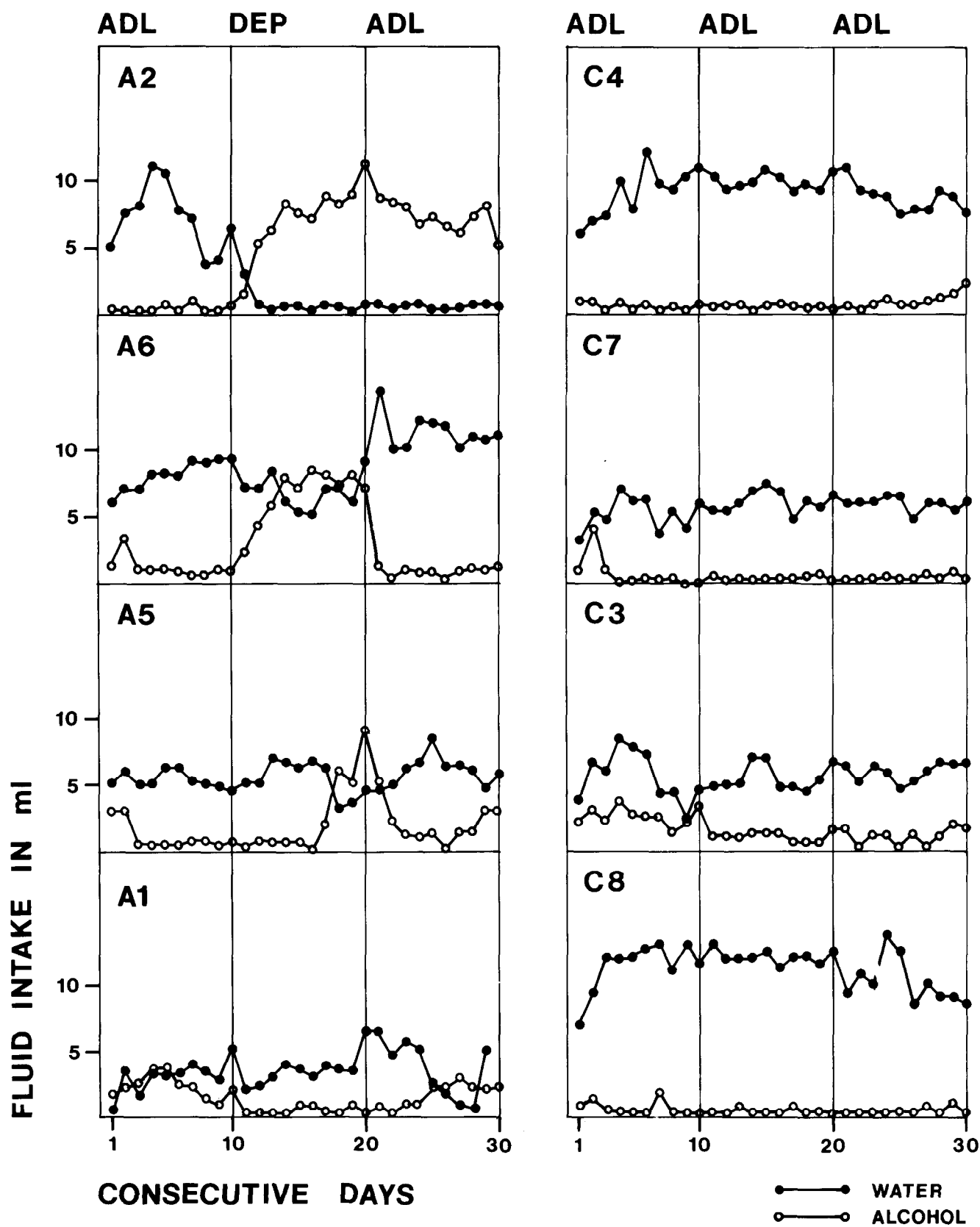


FIG. 1. Fluid intake of mice under ad lib and partial food deprivation schedules.

TABLE 1

TOTAL NUMBER OF CONTACTS AND AMOUNT DRUNK BY THE ANIMALS DURING THE 30-MIN TEST PERIOD, UNDER FOUR CONDITIONS

	Ad lib Food		Partially Food Deprived	
	Water	Alcohol	Water	Alcohol
	Licks	cc	Licks	cc
S ₁	151	.30	9	.00
S ₂	66	.17	3	.00
S ₃	7	.00	22	.05
S ₄	9	.00	2	.00
S ₅	11	.00	2	.00
S ₆	17	.00	13	.00
S ₇	7	.00	6	.00
S ₈	48	.11	34	.04
Σ	316.0	.58	91.0	.09
\bar{X}	39.5	.07	11.4	.01

intake. In the final phase of the experiment, not shown in the figure, 5 out of the 8 animals preferred the ethanol solution by the tenth day, and continued this preference for the duration of the experiment.

EXPERIMENT 2

The results of the previous experiment resemble the findings of Westerfeld and Lawrow [5], and suggest that the random bred mouse might switch ethanol preference during partial food deprivation much like the rat. It is not clear from these results, however, whether ethanol was consumed because of its postingestional effects (e.g., caloric value) or its exteroceptive properties (e.g., taste) possibly modified by food deprivation. Therefore, in this experiment, we investigated the initial response of mice to a 10% ethanol solution in a brief test session under both ad lib and following a 12 day food deprivation condition. Our hypothesis was that, if the sensory properties of ethanol become reinforcing as a result of food deprivation, ingestion of ethanol should occur in food deprived mice immediately at the initial exposure to the solution, well before postingestional consequences (i.e., caloric value) could control its preference.

Animals

Eight naive mice of the same description as before were housed and maintained as indicated previously. However, this time only tap water was available as the fluid source in the home cage.

Apparatus

The preference test apparatus consisted of a clear Plexiglas box (5 × 4 × 5 in) with one side constructed to hold a drinking spout attached to a eudiometer tube. The floor of the box was made of 1/4" hardware cloth. The animal standing on this floor completed a drinkometer circuit when it contacted the stainless steel drinking spout protruding 1/16" into the box. The contacts were recorded on counters and a cumulative recorder.

Procedure

For the initial five days of the experiment, all animals

had ad lib access to food and water in the home cage. During the next 12 days, half of the mice were given 3.2 g food pellets/day, while the other half was provided food ad lib. Water remained available ad lib throughout the experiment. On Days 16 and 17, each animal received a 30 min test period in the Plexiglas box with half the animals getting water on Day 16 and 10% ethanol solution on Day 17, and the other half getting these fluids in reverse order. Following these tests, animals that were under partial food deprivation were given food ad lib; mice that were on ad lib food until this point were put on the partial food deprivation for the next 12 days. On Days 28 and 29, the drinking test described above was again given to all animals; the order of presentation of water and ethanol was balanced among the mice.

Results

Table 1 shows the total number of drinking spout contacts and the amount drunk during the test period under the 4 conditions. A *t*-test for matched pairs indicated a significant difference between the ad lib and deprivation condition with respect to the number of contacts with ethanol ($t = 2.207$, $p < 0.03$, $df = 7$). It is clear from the data that only 3, possibly 4, of the 8 animals showed substantial ethanol ingestion during the test period. However, these animals contacted and ingested the 10% ethanol solution promptly upon first tasting it and 3 of these animals were intoxicated (loss of righting reflex) within 15 min of the beginning of the test.

DISCUSSION

When partially food deprived, rats [5] and now mice have been shown to prefer ethanol to water. It has been suggested that the shift in preference is due to the postingestional reinforcing properties (i.e., the caloric value) of ethanol [1]. The results of the present experiments suggest that in addition to this possibility, an extended partial food deprivation period might modify the initial exteroceptive effects of ethanol. That is in some animals food deprivation might produce primary preference for ethanol; the reinforcement in these instances is to be found in the sensory effects of ethanol and not in its caloric value.

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