Alcohol ingestion in rats following median eminence lesions

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Albino rats were maintained on an alternate-day presentation schedule in which one of three alcohol concentrations (6%, 12%, or 24% v/v) was substituted for water. Under these conditions, a stable volume of ethanol was ingested which was inversely proportional to the concentration. The production of polydipsia through median eminence lesions resulted in an increase in the consumption of the lower concentration of alcohol, but no change in the amount consumed of the two higher concentrations. The results are discussed as they relate to central factors of ethanol ingestion.

Rats do not readily accept concentrations of alcohol that exceed 6%-8% by volume (Richter & Campbell, 1940; Rick & Wilson, 1966), and factors affecting alcohol appetite have been of particular interest. Holman & Myers (1968), utilizing schedule-induced polydipsia, failed to find an increase in ethanol consumption except within the normal preference range, and Cicero & Myers (1969) demonstrated that polydipsia produced by intracranial carbachol injections depressed acceptance of both high and low alcohol concentrations.

Alcohol is known to affect the release of antidiuretic hormone (ADH) into the bloodstream from the sites of synthesis and control of this substance within the hypothalamus and neurohypophysis (van Dyke & Ames, 1951; Crow, 1968). The present study was designed to establish voluntary alcohol consumption in rats, and note the effects upon acceptance of ethanol of brain lesions of the median eminence blocking ADH release producing the polydipsia characteristic of diabetes insipidus.

SUBJECTS

Eighteen male albino rats of the Holtzman strain were used in the study. The animals were approximately 90-110 days of age and naive to alcohol.

APPARATUS

Standard metabolism cages (Acme Metal Products) were fitted with 100-ml drinking tubes, calibrated in .2 ml, and urine collection tubes, calibrated to 1 ml. Lesions were made with a Grass LM-4 radio-frequency device, steel electrodes, and a Stellar-type stereotaxic apparatus.

ALCOHOL SOLUTIONS

All solutions were made with 95% laboratory ethanol mixed with tap water. Concentrations are by volume.

SURGERY

Animals were anesthetized with ether, placed in the stereotaxic apparatus, and bilateral lesions (10 mA at 30 sec) were made at De Groot coordinates A = 5.6, depth -4.0,

lateral .5. At the conclusion of the study, animals were sacrificed with ether, perfused with formalin, and the brains sectioned by the freezing technique.

PROCEDURE

Three groups of six animals were used in the collection of the baseline data—one group for each of the alcohol concentrations (6%, 12%, and 24%). In addition, 12 animals were carried ad lib for an equivalent period prior to the alcohol ingestion tests.

The testing procedure consisted of alternating water and alcohol on successive days for a 19-day period. That is, for a given group, water was withheld every other day (24 h) and alcohol only was presented. The same concentration was successively presented to a group for a total of 10 daily periods. Purina Lab Chow was always available. Measures were made every 24 h of fluid intake, volume of urine, food consumed, and animal weight. Fresh alcohol solutions were prepared at least once during the course of the testing periods.

Subsequent to the initial testing sessions, 12 of the 18 animals (those of the extreme alcohol concentration groups, 6% and 24%) were subjected to the median eminence lesion, and measures were made of daily water consumption and urinary volume for 10 days under ad lib feeding and drinking. Alcohol ingestion tests were then made for each animal with every alcohol concentration, first with the control concentration, then with the opposite extreme, then with the middle concentration.

RESULTS

The control tracing of Fig. 1 shows

Fig. 1. Mean daily consumption of alcohol solutions and water after lesions of the median eminence producing diabetes insipidus. Range brackets indicate variability of individual intake within a 24-h period.

the summary of the baseline data. The "zero concentration" or *ad lib* water intake point represents a mean of 12 animals carried on free drinking prior to the alcohol ingestion tests. The points for the alcohol concentrations of 6%, 12%, and 24% are based on means for 6 animals in each group on the last test day. The alcohol intake data were relatively stable from day to day, and all animals, including those in the 24% alcohol group continued to gain weight throughout the testing sessions. Food consumption dropped on alcohol days, as did urinary volume, in amounts roughly proportional to the concentration. On alternate "water days" fluid intake was increased in proportion to the alcohol concentration offered on the "alcohol days" and the urinary volume was similarly affected. Large individual differences in amount of alcohol accepted were noted for all concentrations (indicated by the range brackets in the figure) as considerable overlap between concentrations occurred.

An effective polydipsia as a result of the median eminence lesions occurred in 5 of the 12 animals submitted to surgery. A criterion of 2 successive days with a minimum of 100 cc of water consumption within the 10-day postoperative period was used to define *diabetes insipidus*. Animals failing to meet this criterion were not included in this report. The upper tracing of the figure shows the means of these five animals tested successively with each of the three concentrations. Repeated measures were made with the 6% and the 24% concentrations, but a single measure was made for the 12% concentration. All lesioned animals showed rapid weight loss during this period, but only one death occurred (not a criterion animal). Pronounced polydipsia was noted for all animals on "water days."

It can be seen from the figure that an increase in fluid ingestion as a result of *diabetes insipidus* occurred only in the case of water and 6% ethanol ($P = .001$ and $.002$, respectively, by Mann-Whitney U test). Differences were not observed in pre- and

postoperative fluid intake with the 12% and 24% alcohol concentrations ($P = .396$ and $.268$, respectively). No concentration sequence effects were noted.

DISCUSSION

The alternate-day presentation schedule proved to be an effective baseline procedure, and the results approximate those functions reported by other investigators (Richter & Campbell, 1940; Holman & Myers, 1968). The failure of the polydipsia resulting from median eminence lesions to increase any but alcohol concentrations within the preferred range is in keeping with those findings of Holman & Myers (1968) in which schedule-induced polydipsia was utilized, but not with those data of Cicero & Myers (1969) in which drug-induced polydipsia actually depressed alcohol appetite. Within the

range of concentrations used here, no depression in intake was noted up to the 24% upper value.

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The relationship between EEG amplitude and the rate of classical conditioning

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Six cats were used as Ss in a classical conditioning study to determine the rate of conditioning when the conditioned stimulus was presented during bursts of EEG activity which exceeded 80 microvolts (experimental group) and 20 microvolts (control group). It was observed that the animals conditioned significantly faster under the high-amplitude conditions than under the low-amplitude conditions. These results were related to differences in cortical excitability during high- and low-amplitude EEG activity.

A considerable amount of effort has been expended in the description of electroencephalographic (EEG) activity following the presentation of a meaningful stimulus (see Morrell, 1961, for review). On the other hand, there is a paucity of information concerning the behavioral consequences of presentation of a stimulus during periods of systematically defined electrocortical activity which precede and are ongoing

at the instant of stimulus presentation (Beck, Doty, & Kooi, 1958). Accordingly, the present investigation was designed to examine the rate of acquisition of a conditioned flexion response (CR) when the conditioned stimulus (CS) was presented during bursts of electrocortical activity which exceeded a defined amplitude.

SUBJECTS

Six adult male cats served as the Ss