

SHORT COMMUNICATION

BEHAVIOURAL CHANGE IN RATS DUE TO CHRONIC ORAL AND SYSTEMIC FORMALDEHYDE\*

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**Abstract:** Impact of chronic formaldehyde exposure in respect of route on behaviour was studied. Preconditioned (environmental) male albino rats (340-400 g) in 3 groups (n=5) under 60 days oral and systemic exposure to 10 mg/kg/day HCHO were examined for their behavioural performance (i.e. short term memory) in Cook's apparatus. Twenty percent rats settled in grade III (unconditioned avoidance response) in the i.p. (i.e. systemic group) whereas in oral fed (HCHO route in drinking water) rats, 60% settled in grade II (conditioned avoidance response) at the end of sixty days.

Key words:

behaviour

formaldehyde

INTRODUCTION

Formaldehyde (HCHO) exposure is common in occupational and non-occupational environments as an urban and industrial air pollutant (1) in tobacco smoke (2, 3), in diesel exhaust fumes (4) and incinerator effluents (5). The exposed individuals have many health problems like lacrimation and irritation of eyes, nasal mucous membranes (6) tightness of the chest, headache, dizziness and complaints like disturbance of memory, mood equilibrium and sleep (7, 8). The rat has been found to be an excellent animal for undertaking studies on experiential and environmental toxins on the cognitive development, thus providing information on its behavioural effects (9, 10). The present work was designed to study the behavioural aspects of HCHO influences on the rat during its oral and systemic exposure and also we have shown by simple techniques (10-12) to check whether HCHO has (1) dose exposure impairment of performance and (3) the HCHO influencing range of short term memory and on its discontinuity, restoration to normalcy.

METHODS

*Experimental methods :* The animals were se-

lected after reinforced screening for conditioning to conditioned avoidance response (CAR) and unconditioned avoidance response (UAR) in a Cook's apparatus (13). Only those rats reaching the standard criterion levels were included in these experiments. All the tests were conducted at the room temperature (27°-32°C).

*Design and training of rats:* Fifteen mature albino male rats weighing 350-400 g were trained to avoid or escape an electric shock applied to their feet. The experimental chamber is a 30 cm cube and rests on a floor grid to which a stimulator is connected. The safety area is a central wooden pole attached to the top of the chamber at the exit side. A buzzer is mounted inside the enclosure and a light is also provided. The chamber is kept in a sound proof wooden enclosure. The stimulator with a built-in timer provides electrical shocks 400 V (0.2 mA) at a frequency of 5 seconds. The duration of stimuli can be controlled by a built-in timer which can be switched into the circuit with either the stimulus (buzzer) to which the animals were conditioned or the stimuli to which the animals were not conditioned (shock) for a period of 30 seconds.

Rats were trained to climb the wooden pole (shock free zone) within 5 seconds (environmental condition-

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ing or secondary conditioned response SCR) or on hearing a buzzer (conditioned avoidance response (CAR) during the 30 seconds and thereafter imparting a mild shock (unconditioned avoidance response UAR) from 31 to 60 seconds (10, 11).

Fifteen rats were divided into three groups (n=5). Controls (group I) received tap water. Test groups (II) received 10 mg/kg, i.p. HCHO and group (III) 10 mg/ml HCHO in drinking water for a period of 60 days. Behavioural performance, body weight and consumption of water during HCHO exposure were recorded.

RESULTS

Animals showed percentage decrease of behavioural performance from secondary conditioned response (SCR) to conditioned avoidance response (CAR) during HCHO exposure in test group II and III and also did not revert to normal activity during HCHO exposure. Fig. 1 and 2 show behavioural responses from grade 1 (SCR) to grade II (CAR) indicating HCHO

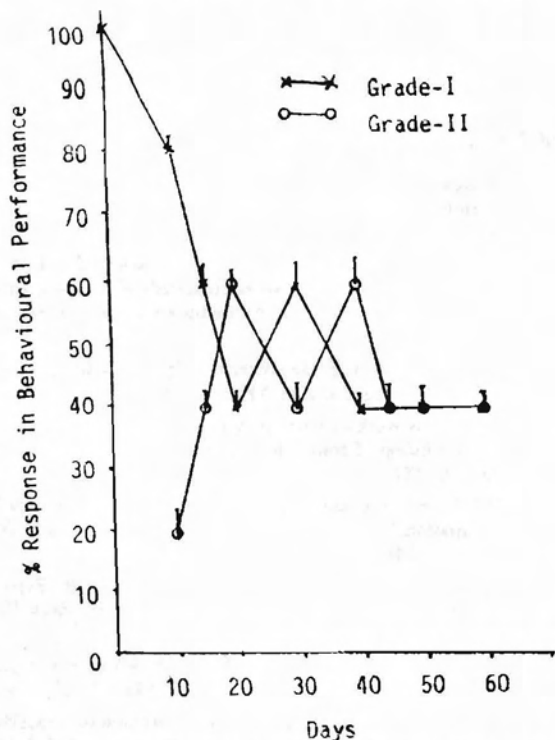


Fig. 1: Percentage of response in behavioural performance from Grade I to Grade II in rats treated with HCHO 10 mg/kg, i.p. for 60 days. Each point represents the mean of five experimental sets and the vertical bars, standard error of mean (SEM).

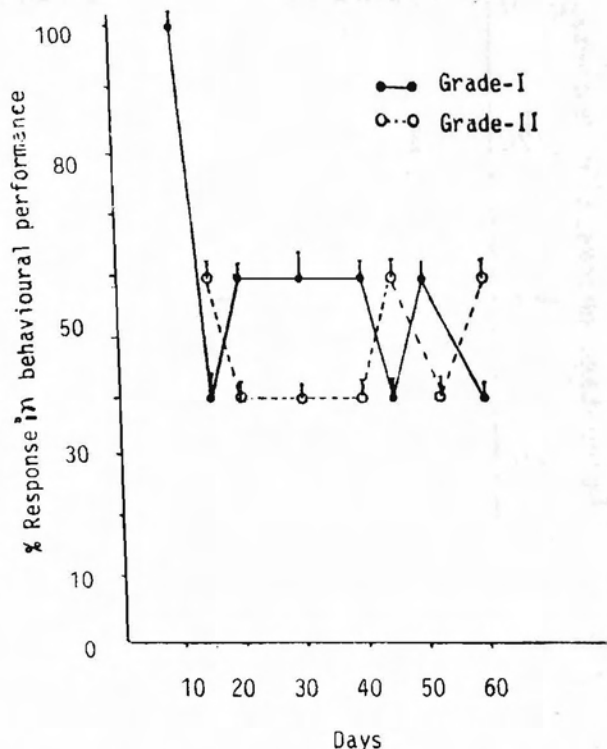


Fig. 2: Effect of HCHO 10 mg/ml in drinking water for 60 days and its percentage behavioural performance in rats. Each point represents the mean of 5 experimental sets and the vertical bars SEM

influences memory trace (permanent engrams) since the animal could not revert to normal psychological activity. There was no significant percentage change in body weight in the test group II and III from the control group I. No changes in posture and muscular activity in both group II and III indicating that HCHO has less effect on the body weight. The results of behavioural performance of both the test group from grade I to II (Fig. 3) indicated that animals less effected and only settled in grade II and still showed the response to UAR and thus showing mild deterioration of rats in the experimental groups.

DISCUSSION

Though the interpretation of animal behaviour to human being is difficult, psychologists suggest that the learning pattern of rats are similar to the pattern of learning in preverbal children of less than 18 months (10). There were several reports about long term

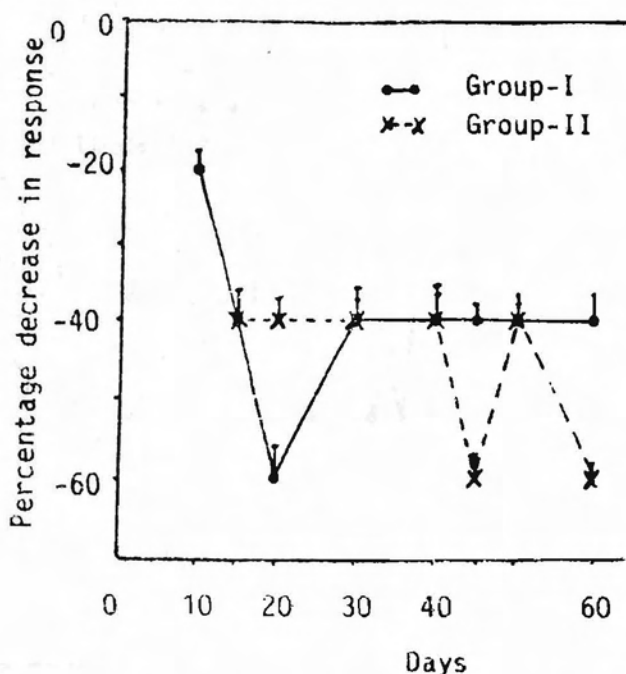


Fig. 3: Percentage decrease in response of behavioural performance in both Group II and III HCHO 10 mg/kg, i.p. and 10 mg/ml in drinking water for 60 days in rats. Each point represents the mean of 5 experiments and the vertical bars, the SEM.

formaldehyde exposure to a range of psychological or behavioural problems or combined neurobehavioural effect (depression, irritability, memory loss, decreased attentional capacity, impact on sleep and equilibrium (7-15) and altered functional state of cortex (16). Electroencephalographic changes such as alpha rhythm enhancement, central nervous effects such as thirst, dizziness, insomnia and apathy, inability to concentrate have been reported (17, 18). There is no direct evidence regarding performance or HCHO influence on the neurotransmitters. This study indicates the neurobehavioural performance in rats which were influenced by HCHO and yet animal's trial to show normal psychological activity inspite of disturbed memory (8) and resultant defects in perception perhaps reflects even in EEG changes such as alpha rhythm enhancement and changes in autonomic nervous system (18).

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