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A note on the effects of some psychotropic drugs on the aggressive behaviour in the ant, *Formica rufa*

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AGGRESSIVE behaviour in lower animals has not been analysed pharmacologically. Inhibition of the motor activity with simultaneous outbursts of aggressiveness seems to be characteristic in ants treated with reserpine (Kostowski, Beck & Mészáros, 1965; 1966). Among the invertebrates, ants are a suitable subject for studies on aggressiveness because of their tendency to attack other species.

We have assessed the influence of drugs on aggressive behaviour in ants and mice.

Methods

ANTS

A plastic container 35 × 35 × 120 mm was divided by a removable wall into two compartments. Into one of these compartments, 10 ants (*Formica rufa*) were placed and into the other, one beetle (*Geotrupes* sp.). This species, because of its massive structure, was resistant to ant bite and poison. After 15 min for calming and adaptation the dividing wall was removed, when immediately the ants attacked the beetle. The number of attacking ants was counted after one, two and three min. Accumulation of formic acid secreted by ants during the attack was prevented by ventilating the container by means of small holes. The beetles could be used repeatedly after one-day intervals.

An index of aggressiveness was assessed. This was the number of attacking ants × 10.

Drugs. Reserpine, lysergic acid diethylamide, phenobarbitone and (±)-amphetamine were given orally with honey; chlordiazepoxide and chlorpromazine, because they were rejected in food, were injected in 0·6% saline into the abdominal cavity in 0·3–0·5 μl amounts with a microsyringe.

MICE

The modified fighting-mice test of Tedeschi, Tedeschi, Muche, Cook, Mattis and Fellows (1959) was used. The amplitude of impulses (50 msec duration, 3 cycles/sec) was calculated as 10 V less pain threshold voltage. The aggressiveness was calculated as a percentage of fighting pairs during 3 min stimulation. The same drugs as for the ants were used. They were injected in 0·9% saline, intraperitoneally.

Results

ANTS

In control experiments the index of aggressiveness was 39, 41 and 44, after one, two and three min respectively. Because the values obtained

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for each minute were in general not statistically distinguishable, the results are presented as a mean index of aggressiveness obtained from all three counts (Fig. 1).

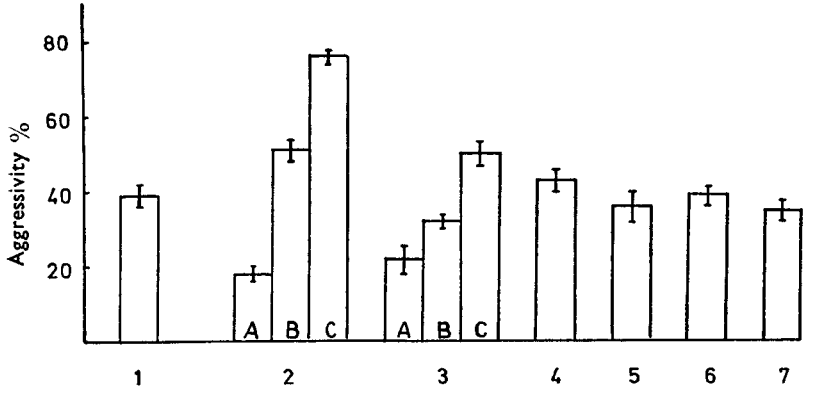

FIG. 1. The average index of aggressivity in ants obtained from 3 counts during 3 min observation. Statistically significant difference calculated accordingly to Student *t*-test at the 5% level. $P < 0{\cdot}05$ for 2A, 2C and 3A. The vertical bars show the standard error. A, 1–3 hr after drug administration; B, after 6–8 hr; C, 18–24 hr. 1, control. 2, reserpine. 3, lysergic acid diethylamide. 4, amphetamine. 5, phenobarbitone. 6, chlordiazepoxide. 7, chlorpromazine.

Reserpine (0·5 μg/mg body weight) decreased aggressiveness after 2–3 hr but in 18–24 hr aggressiveness was markedly increased. Lysergic acid diethylamide (0·025–0·1 μg/mg weight) acts similarly, causing first decrease and subsequently an increase in aggressiveness. Amphetamine (1·0 μg/mg weight), phenobarbitone (5 μg/mg weight), chlordiazepoxide

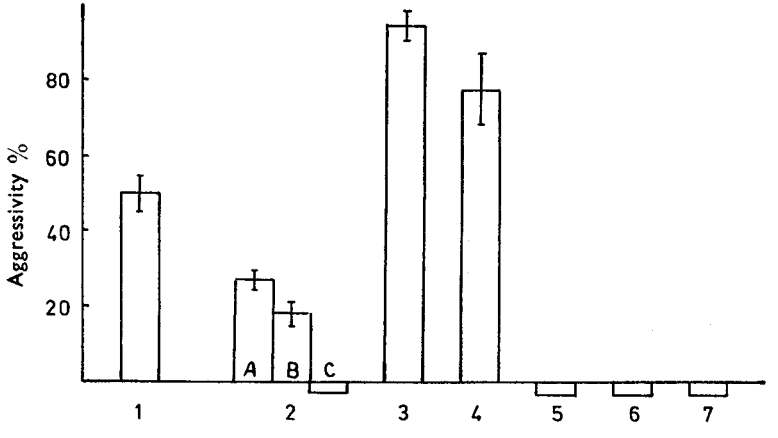

FIG. 2. Aggressivity of mice as a percentage of fighting pairs. 1, control. 2, reserpine (A, after 1–1·5 hr; B, after 6–8 hr; C, after 12–24 hr). 3, lysergic acid diethylamide (after 1–2·5 hr). 4, amphetamine (after 2·5 hr). 5, phenobarbitone (after 3–6 hr). 6, chlordiazepoxide (after 2·5 hr). 7, chlorpromazine (after 3–6 hr). The vertical bars show the standard error. $P < 0{\cdot}05$ for 2A, 2B, 3 and 4.

(0·5 μg/mg weight) and chlorpromazine (0·5 μg/mg weight) did not influence the aggressive behaviour of the ants (Fig. 1). Some calming and ataxia were observed after reserpine and chloropromazine; the other drugs did not produce this effect.

MICE

The percentage of fighting pairs of mice during the 3 min stimulation was 51 in control experiments (Fig. 2). Reserpine (2 mg/kg weight) markedly decreased aggressiveness 1–6 hr after injection and completely suppressed it after 18–24 hr. Lysergic acid diethylamide (0·1 mg/kg) and amphetamine markedly increased aggressivity, with 95% and 78% fighting pairs respectively. Phenobarbitone (10 mg/kg), chlordiazepoxide (1 mg/kg) and chlorpromazine (5 mg/kg) abolished aggressiveness, and calming and ataxia were observed.

Discussion

The results show that the influence of psychotropic drugs on aggressive behaviour differs in ants and mice. Drugs which were potent in mice, such as chlorpromazine, phenobarbitone and amphetamine, had no effect in ants. Reserpine has a biphasic effect in ants—depression of aggressiveness initially, followed by prominent hyperaggressiveness. Lysergic acid diethylamide acted similarly. It seems possible that this biphasic effect may be related to disturbance of brain 5-hydroxytryptamine since this neurohormone was detected in the central nervous system of certain insects (Gersch, Fischer, Unger & Kabitzer, 1961). 5-Hydroxytryptophane decarboxylase has also been detected in small amounts in insect brains (Colhoun, 1964). This 5-hydroxytryptamine or related substances may play a role of inhibitory transmitter in the central nervous system of the ant.

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