The effects of a marijuana extract on the general motor activity of the squirrel monkey*

PERRIE M. ADAMS and ERNEST S. BARRATT
University of Texas-Medical Branch, Galveston, Tex. 77550

The general motor activity of three squirrel monkeys was examined under two dosage levels of a marijuana extract following delays from time of administration of 30, 45, or 60 min. The results indicated the presence of activating as well as suppressing properties which were dosage and delay dependent.

The majority of studies on the effects of marijuana extract or of delta-9-tetrahydrocannabinol (Δ^9 THC) on the spontaneous motor activity of lower animals have been pharmacological in nature and have used the rat or mouse. In an early investigation, Carlini & Kramer (1965) found marijuana extract to have excitatory and sedative properties, dependent upon the dosage and temporal parameters. A dose of 10 mg/kg of an extract produced an increase in maze performance in the rat. Higher dosages of the extract produced a sedative-like slowing of the rat's performance. Holtzman, Lovell, Jaffe, & Freedman (1969) and Moreton & Davis (1970) found dosages of 10-500 mg/kg of Δ^9 THC produced a marked depressant effect following an initial excitatory effect. Studies using primates, though limited, have been consistent. Scheckel, Boff, Dahlen, & Smart (1968) found dosages of 4-64 mg/kg Δ^9 THC typically suppressed the motor performance of squirrel monkeys as well as visual discrimination in rhesus monkeys. Some evidence for a stimulant effect was noted in a continuous avoidance task. Edery (1970) found 100 micrograms/kg of the drug resulted in the rhesus monkey's adopting a huddled posture and maintaining it for 1 to 1½ h.

The present study was designed to examine the dosage and temporal parameters of a marijuana extract distillate (MED)¹ containing 17.1% Δ^9 THC on the general motor activity of squirrel monkeys in an experimental situation free of the constraints of tasks involving reward or shock

SUBJECTS

The Ss were three adult squirrel monkeys supplied by the Ryder

Animal Supply Co. and weighing 400-500 g throughout the study. The Ss were housed individually and maintained on an ad lib diet of fruit and monkey pellets with daily vitamin supplement.

APPARATUS

The experimental cubicle, with interior dimensions of 48 x 20 x 16 in. (h x w x d), was supplied with ventilation, a one-way viewing glass, and sound attenuation. The chamber was designed to allow a range of different responses and included three levers, a platform, and a rope suspended from the ceiling of the chamber. The chamber was illuminated by two 6-W bulbs and a visual display panel consisting of 12 1.5-W bulbs, which were divided into two groups with alternating illumination when a certain lever was depressed inside the chamber. A grid floor served as the base of the chamber.

PROCEDURE

Each of the monkeys was placed in the apparatus daily for 15 min. During the daily session, the amount of time

spent of each activity was recorded by an O, using a timer with 1-sec accuracy. The daily sessions were recorded until the S's behavior in the chamber stabilized for 3 successive days (approximately 15 days). The marijuana extract was suspended in Tween 80 and saline and administered orally. Dosage levels of 4 and 8 mg/kg (.684 and 1.368 mg/kg Δ^9 THC) MED were administered to each S with a delay of 30, 45, or 60 min before behavioral observation. The sequence of delay-dosage combinations was varied across the Ss so that no bias in the order of treatments was present. A minimum of 3 days between treatment administrations was maintained throughout the study. Twenty-four hours after the last delay-dosage treatment, the Ss were given an additional session to determine the posttreatment level of motor activity. A modified form of the behavior activity index (Francois, Barratt, & Harris, 1970) was used to evaluate the general activity of the Ss under the various treatments, with additional items added to the index because of the availability of additional potential activities.

RESULTS

The behavioral profiles for each monkey were different with regard to the amount of time spent in the various types of activity. It was possible to determine several activities in which all of the Ss spent some time each session. The time spent huddling under the influence of Δ^9 THC (Fig. 1) was markedly different compared to pre- and postdrug levels. The directionality of the change was a function of the location of the huddling behavior. The level of time spent huddling on the platform was decreased, while the time spent in floor huddling increased. The changes

Fig. 1. Mean time spent huddling under the dosage-delay conditions.

*This research is supported by a U.S. Department of Justice grant, No. NI 70-056, and by the Physiological Psychology Branch, Office of Naval Research, Contract No. N0014-68-A-0105-0002.

Fig. 2. Mean time spent active under the dosage-delay conditions.

in time spent were significant for the 45- and 60-min delays under 4 mg/kg and from all of the delays under 8 mg/kg ($p < .05$, Friedman two-way analysis of variance).

The time spent in active behaviors (exploration, scratching, looking about) under the effects of Δ^9 THC was different for the two locations (Fig. 2). The level of floor activity decreased significantly ($p < .05$) at 4 and 8 mg/kg dosages with 60-min delays. Platform activity increased at the 4 mg/kg dosage but was significantly above baseline only for the 30- and 45-min delays at 8 mg/kg. A dose-delay relationship can be seen for both of the locations. The overall level of activity is suppressed by the higher dosage with a 60-min delay.

DISCUSSION

The results of the present study

generally support the findings of the earlier investigations examining the effects of marijuana on spontaneous activity or active performance measures. The present study extends the earlier work with primates and rats to a number of motor activity measures which are more difficult to measure in lower animals but free of the constraints of paradigms using reward or aversive stimuli. The findings illustrate the sedative-like properties present in marijuana noted by Scheckel et al (1969) and Edery (1970) in primates but also indicate the presence of activating properties under certain dosage-delay conditions dependent upon the behavioral measure under investigation. It is concluded that there are bidirectional changes, activation followed by suppression, in the behavioral profile

of the primate under the effects of marijuana and that motor activity measures are highly sensitive to its dosage and temporal parameters.

REFERENCES

- CARLINI, E. A., & KRAMER, C. Effects of cannabis sativa (marijuana) on maze performance of the rat. *Psychopharmacologia*, 1965, 7, 175-181.
- EDERY, H. Psychopharmacological actions of cannabinoids in experimental animals. *Toxicol.*, 1970, 8, 162-163.
- FRANCOIS, G. R., BARRATT, E. S., & HARRIS, C. S. Assessing the spontaneous cage behavior of the squirrel monkey (*Saimiri sciureus*). *Primates*, 1970, 11, 89-92.
- HOLTZMAN, D., LOVELL, R. A., JAFFE, J. H., & FREEDMAN, D. X. 1-delta-9-tetrahydrocannabinol: Neurochemical and behavioral effects in the mouse. *Science*, 1969, 163, 1464-1467.
- MORETON, J. E., & DAVIS, W. M. Effects of delta-9-THC on locomotor activity and on phases of sleep. *The Pharmacologist*, 1970, 12, 258.
- SCHECKEL, C. L., BOFF, E., DAHLEN, P., & SMART, T. Behavioral effects in monkeys of racemates of two biologically active marijuana constituents. *Science*, 1968, 160, 1467-1469.

NOTE

1. MED is processed as follows: marijuana plant material is extracted with 95% ethanol; water is added to the alcohol extract; by the system of immiscible solvents, hexane is added to the alcohol and water mixture and nonsoluble active substances are removed; hexane is removed by evaporation under reduced atmospheric conditions; the material containing no hexane is then molecular distilled; cannabinoids are unchanged and present in the same ratio but increased about 10 times in strength.