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BRIEF COMMUNICATION

Chronic Nicotine Induces a Specific Appetite for Sucrose in Rats

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JIAS, L. M. AND G. ELLISON. *Chronic nicotine induces a specific appetite for sucrose in rats*. PHARMACOL BIOCHEM BEHAV 35(2) 489–491, 1990.—Thirty female albino rats were implanted with subcutaneous pellets releasing nicotine or amphetamine in order to study the effects of chronic pharmacological treatment on food intake and body weight. The pellets were removed after tolerance (a decrease in anorectic properties of the drugs) had developed. Nicotine administration produced a specific appetite for sucrose both during and following treatment ($p<0.05$).

Nicotine Specific appetite Sucrose Chronic drug treatment

DIETARY self-selection has been studied extensively, and certain pharmacological agents have been shown to selectively decrease the intake of specific nutrients in laboratory animals (2,5) as well as humans (15). Amphetamine and nicotine are two stimulants that are known for their anorexic properties. Amphetamine treatment produces an initial anorexia and weight loss, followed by a gradual increase in food intake with extended administration (1, 4, 11). Rebound hyperphagia and weight gain occur upon drug discontinuation (10). Nicotine has been found to also cause a transient weight loss which is reversed when treatment is discontinued (1, 7, 12). Although the general effects of these drugs on appetite are similar, specific effects appear to differ. Amphetamine has been shown to decrease fat intake in rats (9), while nicotine is believed to selectively decrease sucrose consumption (5,6). A specific appetite for sucrose has been noticed upon cessation of nicotine treatment (5), but a problem arises when concentrated sucrose solutions (i.e., 16–32%) are the selection option. At these concentrations, rats maintain their caloric intake at control levels, but sucrose constitutes the largest portion of calories (8). Thus, it is difficult to distinguish if intake was caused by a hedonistic preference for the sweet taste or regulation of caloric intake. Sorenson, Ellison and Masuoka (14) suggest that a dilute (3%) sucrose solution does not elicit extreme consumption, and, thus, this concentration appears more useful for determining drug effects on sucrose intake.

The purpose of this experiment was to study the effects of chronic pharmacological treatment obtained via subcutaneous pellets releasing nicotine or amphetamine. This study investigated if a specific food suppression, caused by drug treatment, produced a specific appetite for that food upon cessation of treatment. Based upon the previous literature, it was predicted that amphetamine treatment would selectively decrease fat intake and produce a specific fat appetite after treatment, while nicotine would have similar effects on sucrose intake.

METHOD

Subjects

The subjects were 30 individually housed female albino rats initially weighing 259–300 g, maintained on a 12/12 reverse day-night schedule with constant red light. After a period of gentling, the animals were put on a feeding schedule; powdered Purina rat chow, placed in steel food cups with spill proof lids, was available once daily from 1000 hr until 1200 hr, during the dark cycle. The amount consumed and infrequent spills were recorded daily. Water was available ad lib.

Materials

The subcutaneous pellets were constructed as described by Nielson and Ellison (13) and Erickson, Salomon, Stavchansky, Koch and McGinity (3) to release an average rate of 2.1 mg amphetamine or 3.4 mg nicotine base (Sigma Chemical Company) respectively per day. The pellets were implanted and removed under local anesthetic; the skin was infiltrated with 2% Lidocaine, and several minutes later a small incision was made in the skin. The pellet was inserted subcutaneously, and wound clips were used to suture the skin. Control animals were implanted with pellets containing saline (nicotine pellet) or polyethylene glycol (amphetamine pellet).

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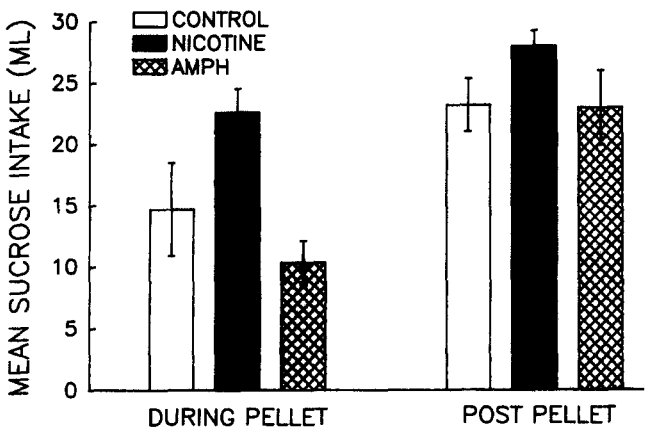

FIG. 1. Mean (±S.E.) two-hr intake as a function of a specific appetite for sucrose during and following drug treatment.

Procedure

The subjects were randomly divided into three groups matched for body weight, and the pellets were implanted. When tolerance developed (indicated by food intake returning to control level), specific appetites were tested. Pure cane sugar was dissolved in distilled water to yield a 3% solution, and calibrated bottles containing this sugar water replaced the water bottles during the 2-hr feeding interval for two consecutive days. The bottles were then filled with Mazola corn oil which was available in addition to water during the two following feeding intervals. The pellets were removed after 22 days, and specific appetites were retested following a three-day period of adjustment. During the feeding interval, oil was available for two days followed by sugar for the next two days.

RESULTS

In a test conducted four days after pellet implantation, powdered chow intake was initially decreased from controls for both experimental groups, $F(2,29) = 13.968$, $p<0.001$. Figure 1 shows the results of the specific appetite tests. In general, although all animals consumed more sucrose after drug treatment, $F(1,30) = 20.330$, $p<0.001$, the nicotine animals consumed significantly more sucrose than control or amphetamine animals, $F(2,29) = 6.534$, $p<0.005$. During drug treatment, there was a significant difference in sucrose intake, $F(2,29) = 5.332$, $p<0.05$, and post hoc *t*-tests revealed nicotine animals' consumption was greater than either control ($p<0.05$) or amphetamine animals' ($p<0.005$) consumption. Between group differences for oil intake were not significant, yet all animals decreased oil intake following removal of the pellets, $F(1,30) = 5.008$, $p<0.05$.

DISCUSSION

It was found that all animals tended to increase sucrose consumption following pellet removal. Several reasons may account for this increase. The animals may have had a larger appetite following the surgery; however, a decrease in oil consumption invalidates this explanation. A more likely explanation is that, since the animals were exposed to sugar for the first time during drug treatment, this prior experience with the sweet taste may have resulted in greater consumption following pellet removal.

Nicotine was found to cause a specific sucrose appetite during drug administration which further increased when treatment was ended. This finding differs from previous research which reported that nicotine treatment decreases sucrose intake (5). Several experimental differences may explain this controversy. First, nicotine was administered subcutaneously through slow release pellets, whereas prior experiments delivered drug through miniosmotic pumps or injections. Also, past experiments have only included male rats, whereas the effects of nicotine on female rats were examined in this study. It has previously been suggested that nicotine has different effects on males and female rats (7). Thus, it is possible that nicotine treatment deceases sucrose intake in male rats while increasing sucrose intake in female rats, and future studies should include both male and female rats in order to clarify this difference. Other possible differences may be the result of dilute sucrose solutions and delay testing in the present experiment.

A decrease in fat intake during amphetamine treatment, as noted by Kanarek, Ho and Meade (9), was not found. This may have been due to the development of tolerance at the time of testing. Since all animals were found to decrease fat intake following removal of the pellets, the taste of liquid fat, which was used in the present study instead of lard, may have been aversive.

The results of this experiment suggest that smokers may be at risk of craving sugar if they become tolerant to the dose of nicotine that they are receiving. This craving for sugar will increase if they quit smoking, and some smokers may tend to smoke more in order to avoid developing this craving. Smokers need to be aware of these effects of nicotine and moderate their behavior accordingly in order to avoid undesired weight gain.

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