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Nepeta cataria L. var. citriodora (Becker) increases penile erection in rats

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ABSTRACT

Ethnopharmacological relevance: Nepeta cataria (NC), catnip, induces pleasure in cats and humans.
Aim of the study: Because sexual behavior is involved in pleasure, the effect of NC on sexual behavior and penile erection was evaluated in male rats that were acutely fed chow enriched with 10% NC leaves. Further, yawning was monitored because we previously demonstrated that NC modifies dopaminergic-related behaviors and that sexual behavior is closely linked with the dopaminergic system. The general activity and the motor coordination were examined to investigate the possible motor and emotional interferences of the sexual performance.
Material and methods: Male rats of the NC group received for a 4 h period the chow enriched with 10% NC leaves while the control groups received regular chow. Fifteen min after the end of the 4 h period of NC feeding the sexual behavior, apomorphine-induced penile erection and motor coordination were observed; the general activity in the open field was assessed 0, 15, 30 and 60 min after treatment.
Results: NC treatment increased male rat's penile erection. A slightly facilitation on male rat sexual behavior and a decreased in general activity of NC treated rats were observed. No effects on motor coordination and yawning episodes were detected by the NC treatment.
Conclusions: It was suggested that NC increases penile erection and slightly improves male rat sexual behavior by an action on dopaminergic systems.

1. Introduction

Nepeta cataria (NC), popularly called catnip or catmint, is a perennial herb belonging to the mint family (Lamiaceae). NC has long been used in North American popular medicine and in teas, dyes, and infusions. *Nepeta* species are widely used because of their antispasmodic, expectorant, diuretic, antiseptic, febrifuge, antitussive, and antiasthmatic effects (Smitherman et al., 2005). Also this plant that has been used extensively in toys for pets (Smitherman et al., 2005). Catnip alters behavior and produces pleasurable sensations in both wild and domestic cats as well as in other mammals (Hatch, 1972). One study also associated pleasurable experiences with catnip in humans. The dried leaves or extract, when smoked, produced symptoms similar to those of marijuana and LSD (Jackson and Reed, 1969).

Because sexual behavior is involved with pleasure, the aim of the present study was to evaluate the sexual behavior and apomorphine-induced penile erection in male rats acutely fed chow enriched with 10% NC leaves. The role of NC in sexual behavior has not yet been elucidated.

It was also measured the apomorphine-induced yawning episodes, because previously we found that the ingestion of NC modifies dopaminergic-related behaviors with an amphetamine-like effect (Massoco et al., 1995). Moreover, sexual behavior is closely linked to the dopaminergic system. Among the central neurotransmitters involved in the control of sexual behavior, dopamine is one of the most extensively studied. Several studies provide neuropharmacological, biochemical, electrophysiological and psychobiological evidence that dopamine plays a pivotal role in the control of different aspects of sexual behavior (Hsieh et al., 2004; Dominguez and Hull, 2005; Pfaus, 2009).

The general activity in the open field and the motor coordination were also examined to investigate the possible motor or emotional effects on the sexual performance of male rats.

2. Material and methods

2.1. Animals

Male and female Wistar rats (100 days of age) from our colony were used. The animals were housed in groups of five in polypropy-

Abbreviations: Var., variety; NC, *Nepeta cataria*; Min., minutes; h, hours; AIN, American Institute of Nutrition; PVN, paraventricular nucleus.

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lene cages with metallic cover (40 × 50 × 20 cm) at controlled room temperature (22 ± 2 °C), humidity (65–70%) and artificial lighting (12 h light/12 h dark cycle), with free access to food and filtered water. Thirty-four male rats were maintained in reverse lighting conditions (lights on 22:00 h) for at least one month before the onset of experiments. These animals were used in sexual behavior, penile erection and yawning behavior studies that were performed between 14:00 and 17:00 h, during the dark period. Another thirty-eight male rats were maintained in normal artificial lighting conditions (lights on 06:00 h) and were evaluated in the open field and motor coordination studies during the light period, between 14:00 and 17:00 h. The rats used in this study were maintained in accordance with the guidelines of the Committee on the Care and Use of Laboratory Animal Resources of the School of Veterinary Medicine, University of São Paulo, Brazil. These guidelines are similar to those of the National Institutes of Health, Bethesda, MD. Experiments were carried out in accordance with good laboratory practice (GLP) protocols and with quality assurance methods.

2.2. Botanical material collection and N. cataria-enriched chow production

N. cataria L. var. citriodora (Becker) was collected on May 10, 2005 (autumn season), in Serra Azul Street, 308, Piracicaba, SP, Brazil, number 001/205. Specimens were identified by botanist Oriana Favero, PhD, from the Universidade Presbiteriana Mackenzie. A voucher specimen was deposited in the Herbário Municipal de São Paulo as collection number PMSP8986.

After collection, the leaves (3.195 kg) were completely dried in an air circulation stove set at 40 °C, ground in a hammer mill to a final granulometry of four mesh and mixed with regular powdered chow in a 10% proportion until complete homogenization. The temperature employed to dry the NC leaves was not effectiveness to decompose the active compounds. This is a usual procedure in a phytochemical laboratory, to eliminate water before the material were milled.

According to the American Institute of Nutrition (AIN), the chow used in this study, which was mixed with 10% NC leaves, maintained the minimal amounts of essential nutrients recommended in the AIN-93G diet formulated for the adequate development of rats (Reeves et al., 1993).

2.3. Treatments

Animals were distributed randomly into control and NC groups. The rats of the NC group received the chow enriched with 10% NC leaves for a 4 h period. The control groups received regular chow (Nuvital®, Nuvital company, São Paulo, Brazil), which was balanced and specific to lab animals, without the plant leaves during the same period. We chose the route of the plant administration because this is the natural way of the plant consumption.

2.4. Chow consumption evaluation

In all behavioral experiments (sexual behavior, apomorphine-induced penile erection, apomorphine-induced yawning, general activity in the open field and motor coordination), the food consumption was measured (weight, g) before and after the 4-h feeding period. Both, rats of control and experimental groups were starved 24 h before the experiment. This period and the plant concentration were chosen because previous data showed that that 4 h of feeding with 10% plant material produced clearly antidepressive effects the learned helplessness model of depression (Figueiredo et al., 2005).

2.5. Sexual behavior test

Eighteen male rats (9 for each group) were used to study the effects of NC feeding on sexual behavior. The test was conducted in a wooden box (56 × 32 × 32 cm) with a moveable cover, frontal glass and pine shavings on the floor. The test room was illuminated by two 25-W red lamps. Male rats were allowed to mount ovariectomized females that had been sexually activated with exogenous estradiol (50 μg/kg subcutaneously [s.c.], 54 h prior to the experiment) and progesterone (2.0 mg/kg s.c., 6 h prior to the experiment). The female lure rats were tested once for receptivity before being placed with the males. Fifteen min after the end of the 4 h period of NC feeding, male rats, individually, were allowed to acclimate to the behavior box for 5 min, after which a receptive female was introduced and sexual behavior was monitored for 40 min. The following parameters were recorded: (1) first mount latency (min, without intromission); (2) first intromission latency (min, mount with vaginal insertion); (3) first ejaculation latency (min); (4) first post-ejaculatory mount latency (min); (5) number of mounts until the first ejaculation; (6) number of intromissions until the first ejaculation; (7) total number of intromissions in 40 min; and (8) total number of ejaculations in 40 min.

2.6. Penile erection and yawning tests

Sixteen male rats (8 for each group) were used for penile erection and yawning studies. Fifteen minutes after the 4-h NC feeding period, each rat was simultaneously tested for penile erection and yawning induced by 0.08 mg/kg of apomorphine s.c. Moderate doses (0.05–0.2 mg/kg) facilitate male sexual responses, including penile erection (Andersen and Tufik, 2005) and yawns (Zarrindast and Farahvash, 1994). Immediately after the apomorphine treatment, each animal was individually placed into a glass box (30 × 30 × 30 cm) with a mirror wall. This box was elevated 10 cm above a mirror (45 × 45 cm). The rats were observed for 60 min, during which the latency (s) and frequency of spontaneous penile erection (only when the rat displayed full erection and bent down to lick its penis) as well as the latency (s) and frequency yawns were recorded. Frequency of spontaneous penile erection was defined as the number of genital reflexes, and latency (s) was defined as the time elapsed between the injections to the first penile erection. Yawning frequency and latency (s) were recorded by visual observations. The device was washed with a 5% alcohol/water solution before placement of the animals to obviate possible biasing effects from odor clues left by previous rats.

2.7. General activity in the open field test

Eighteen male rats (9 for each group) were used for general activity studies in the open field. Fifteen min after the end of the 4-h NC feeding, rats were individually observed in the open field in five sessions: 0, 15, 30, 60 and 90 min. The device was similar to that described by Broadhurst (1960), i.e., a round arena 96 cm in diameter surrounded by a 25-cm high enclosure, painted white and subdivided into 25 parts painted black. Hand-operated counters were employed to count the locomotion frequency (number of floor sections entered) and rearing frequency (number of times an animal stood on its hind legs) and a chronometer was used to measure immobility duration (total time in seconds without spontaneous movements). For open-field observations, each rat was individually placed in the center of the arena and its behavioral parameters were recorded for 5 min. The device was washed with a 5% alcohol/water solution before placement of the animals; control and experimental rats were intermixed.