Effects of Oral Administration of Nicotine on Sex Hormone Concentrations of Adult Albino Rats

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ABSTRACT

Nicotine is an additive alkaloid component of the cigarette smoke. Principal sex hormones are testosterone and estrogen. This study is undertaken to investigate the effect of oral administration of nicotine on the sex hormone concentrations in an animal model. 30 adult albino rats weighing between 180-200g were divided into three groups. Group A (control) consisted of 10 rats (5 males and 5 females) and received normal rat chow and water. Group B comprised 10 female rats and received 1.0mg/kg body weight of nicotine. Group C comprised 10 male rats and received 1.0mg/kg body weight of nicotine. The study lasted for 30 days. At the end of the experiment, blood samples were collected and plasma levels of testosterone and estradiol were determined by enzyme immune assay procedure. The result showed a significant decrease in plasma estradiol and testosterone levels in Groups B and C respectively. The result suggests that nicotine has a negative effect on the plasma concentrations of sex hormones of adult albino rats.

Keywords*: Nicotine, estradiol, testosterone, rat.*

INTRODUCTION

Leaves of tobacco, *Nicotianatabacum* yields nicotine, a colorless, volatile base (PK_2 = 8.5) that turns brown and acquires the odor of tobacco on exposure to air. It is one of the few natural liquid alkaloids. It is of considerable medical significance because of its toxicity, presence in tobacco and propensity for conferring a dependence on its users (Brunton, Lazo and Parker, 2006). Nicotine can be consume in different forms ranging from smokeless tobacco products such as snuff and chewing tobacco to the more often consume form, smoke tobacco. Cigarette tobacco contains alkaloids in addition to other several substances (Russell, Jawis, Devitt and Feyerabend, 1981). Nicotine represents 90%-95% of the total alkaloids. It is absorbed quickly through the respiratory tract, oral mucosa and skin. Approximately 80%-90% is metabolized by the liver, but the kidney and lungs are involved as well (Armitage *et al*, 1975). The average cigarette contains 6 to 11g nicotine and delivers about 1 to 3mg nicotine systemically to the smoker, bioavailability can increase as much as threefold with intensity of puffing and technique of the smoker (Henningfield, 1995 and Benowitz, 1998). Nicotine crosses the blood- brain barrier reaching the brain within 10-20 seconds after inhalation (Le houezec, 2003). In the developed countries, cigarette smoking is a major cause of morbidity and mortality. This is being

replicated in the developing countries because of change in lifestyle (Kapoor and Jones, 2005). In addition to other effects, cigarette smoking inhibits spermatogenesis and causes decreased steroidogenesis in man (Aydos, Given, Can and Ergun, 2001, Mlynarcikova, Fickova and Scsukova, 2005). Tanko and Christiansen (2004) report its anti-estrogenic effect in women. Principal sex hormones include estrogens (female) and testosterone (male). In normal non pregnant female estrogens are secreted in significant quantities only by the ovaries, although minute amounts are also secreted by the adrenal cortices. During pregnancy, tremendous quantities of estrogens are also secreted by the placenta. Only three estrogens are present in significant quantities in the plasma of the human female; â-estradiol, estrone, and estriol (Nadal, Diaz and Valverde, 2001; Nelson, 2004; Nilsson *et al,* 2001). The testes secrete several male sex hormones which are collectively called androgens, including testosterone, dihydrotestosterone and androstenedione. Testosterone is so much more abundant than the others that one can consider it to be the significant testicular hormone (Rhoden and Morgentaler, 2004). Many young people are still indulging in cigarette smoking despite negative health consequences. The present study was undertaken to evaluate the effect of nicotine on sex hormones of adult albino rats.

MATERIALS AND METHOD

This study was carried out between July and August 2012, in the Department of Physiology, Anambra state Univeristy, Uli.

Drug: Nicotine hydrogene tartrate (95% nicotine) was used in the study. The nicotine dosage freshly prepared in normal saline for each group of animals was delivered at 1.0mg/kg body weight. The working solutions were stored in foil-wrapped glass bottle at 4^0C for no longer than seven days.

Animals*:* 30 healthy adult albino rats of Wistar strain weighing between 180-200g were used in the study. The animals were housed under standard conditions of temperature (23 ± 2^0C), humidity and 12h light (7.00am-7.00pm). They were kept in wire meshed cages and fed with commercial rat pellets and allowed water *ad libitum*.

Experimental Design*:* The animals were divided into three groups of 10 rats each. Group A animal (control) comprised 5 male and 5 female rats. They received only water and normal rat chow. Group B consisted of 10 female albino rats and received 1.0mg/kg nicotine. Group C consisted of 10 male albino rats and received 1.0mg/kg nicotine. The experiment which lasted for 30 days was conducted in accordance with the National and Institutional Guidelines for the Protection of Animal welfare. At the end of the experiment, the rats were anaesthetized with chloroform after overnight fast. Blood was collected via cardiac puncture into heparinized screw cap bottles. The samples were taken to the chemical pathology laboratory of NnamdiAzikiwe University teaching Hospital Nnewi (NAUTH) for enzyme immune assay (EIA). The parameters measured were testosterone and estradiol according to Tietz (1995).

Statistical Analysis*:* The data were expressed as Mean ± SEM (standard error of mean). The student's t-test was applied and p-values were determined. Differences were considered significant at $P<0.05$.

RESULTS AND DISCUSSION

The results showed that the estradiol level in group B was significantly decreased compared with the control group. Furthermore, the level of testosterone was significantly decreased in group C compared with the control group.

Table 1: Testosterone level in male albino rats administered with nicotine: Result of enzyme immuno-assay test.

Group	**Testosterone level (ng/ml) X ± SEM**
Control: n = 5	1.602 ± 0.036
Test: n = 10	1.602 ± 0.09

Table 2: Estradiol level in female albino rats administered with nicotine: Result of enzyme immuno-assay test.

Group	**Estradiol level (pg/ml) X ± SEM**
Control: n = 5	18.04 ± 0.005
Test: n = 10	2.90 ± 0.0

The decrease in plasma testosterone concentration observed in this present study may be attributed to its possible role in causing a reduction in luteinizing hormone (LH) concentration. In the male rats the circulating LH is responsible for maintaining the normal plasma testosterone concentration. Testosterone is secreted by the interstitial cells of Leydig in the testes but only when they are stimulated by LH from the anterior pituitary gland. Furthermore, the quantity of testosterone secreted increases approximately in direct proportion to the amount of LH available. Testosterone has been reported to act on the semniferous tubules to initiate and maintain spermatogenesis (Sharpe *et al*, 1992). The arrest of spermatogenesis may probably occur as a consequence of reduction in serum testosterone which had been shown to be essential for the completion of meiotic division during spermatogenesis.

The findings in this study are in accordance with previous findings where it has been established that nicotine administration decreased the testicular androgenic enzymes along with plasma testosterone and sperm counts in mature male albino rats (Yamamoto Isoyama, Sofikitis and Miyagawa, 1998; Oyeyipo, Raji, Emikpe and Bolarinwa, 2010). In addition, Oyeyipo, Raji, Emikpe and Bolarinwa, 2011 investigate the effects of nicotine on sperm characteristics and fertility profile in adult male rats and conclude that nicotine had a dose-dependent deleterious effect on the sperm characteristics and that fertility was ameliorated by nicotine cessation. The decrease in plasma estradiol concentration may be attributed to the possible role of nicotine in causing a reduction in follicle stimulating hormone (FSH) level and/or direct negative effect on reproductive organs. In the female rats, the circulating FSH is responsible for maintaining the normal plasma estrogen level. A decrease in FSH would lead to a reduction in estradiol level.

In the present study, oral administration of nicotine caused a decrease in estradiol concentration. This is equally in keeping with the result of the study carried out by Iranloye and Bolarinwa (2009) which showed that nicotine has adverse effects on fertility potentials of female albino rats by reducing the weight and disorganizing the histology of some vital viscera and reproductive organs. In conclusion, this study showed that oral administration

of nicotine caused a significant reduction in principal sex hormones: testosterone and estradiol and may lead to a compromised reproductive activity in nicotine users.

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