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Effect of Pyrethroid Inhalation on the Testis of Albino Rat

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Abstract: The effect of inhalation of the pyrethroid tetramethrin on the testicular tissue of the albino rats was studied. Rats inhaled tetramethrin for 6 weeks showed significant loss in the testes weight and reduction in the diameter of the seminiferous tubules. Moreover, histological examination of the testis revealed destruction of the seminiferous tubules, reduction of spermatogenic cells and degeneration of Leydig cells. It is speculated that tetramethrin may be responsible for inhibition of spermatogenesis in the rats through suppression of testicular androgenic activity.

Key words: Pyrethroid - testis - rats - spermatogenesis.

Introduction

Natural pyrethrins produced from the pyrethrum plant have been used for controlling insects for many years. Recently, due to the presistence of these pesticides in the environment, structure similar to these pyrethroids have been synthesized (Casida, 1973).

These insecticides are widely applied, in view of the fact that they have been proved to possess a highly insecticidal activity as well as a broad spectrum of high initial toxicity action on several types of pests (Narahashi, 1971).

The toxicity of pyrethroid insecticides to mammalian animals has received much attention in the recent years. Animals exposed to these insecticides exhibited changes in their physiological activities beside other pathological effects (Sakr, 1999).

Many studies indicated that insecticides have harmful influence on the male reproduction El-Samannody et al. 1998, (Alhazza and Bashandy, 1998).

This stimulated us to study the effect of the pyrethroid "tetramethrin" on the testicular tissue of the rat.

Materials and Methods

Sexually mature male albino rats (Rattus norvegicus) weighing 275 ± 5 g. were used. Animals were kept in the laboratory under constant conditions of temperature (24 ± 2 °C) for at least one week before and throughout the experimental work, being maintained on a standard diet and water were available ad libitium. Animals were divided into two groups. Rats in the first group (25 animals) each inhaled one ml of the pyrethroid tetramethrin once every two days for 6 weeks. Animals were kept individually in a closed cage and 1 ml of the pyrethroid was sprayed in each cage for 5 minutes (Sakr, 1999). This pyrethroid is obtained from local markets and is used as an insecticide for cockroaches and ants. It contains 0.20% tetramethrin, 1% propoxur and 98.8% solvents and propellants. Animals in the second group (15 animals) were used as controls.

The treated animals and their controls were sacrificed by decapitation after 2, 4 and 6 weeks of treatment. For histological examination, their testes were removed, weighed and fixed in Bouin's fluid. After fixation, tissues were dehydrated through ascending grades of ethanol, cleared in xylene and finally embedded in paraffin wax. Specimens were sectioned at 5 microns and stained with haematoxylin and eosin. Seminiferous tubules diameter were measured with an ocular micrometer. For statistical analysis of the data, the Student's-t test was used.

Results

Data in Table 1 show that treating rats with tetramethrin caused decrease in the testis weight and this decrease became significant ($P < 0.05$) after 6 weeks of treatments. There was likewise significant decrease in the diameter of the seminiferous tubules in the treated rats.

Table 1: Effects of tetramethrin on the testis weight and seminiferous tubules diameter of rats.

Animals Group	Testis weight in g (Mean ± S.D)	Diameter of seminiferous tubule in mm (Mean ± S.D)
Control	1.94 ± 0.02	0.28 ± 0.01
2 weeks-treatment	1.83 ± 0.03	0.26 ± 0.1
4 weeks	1.64 ± 0.16	0.24 ± 0.02
6 weeks	1.20 ± 0.14*	0.18 ± 0.01*

(*) Significant at $P < 0.05$.

Histological examination of testis of control rat showed normal arrangement of the spermatogenic layers. The seminiferous tubules were rounded and are separated by a thin intertubular connective tissue with Leydig cells. The germinal epithelia are formed of normal spermatogenic layers represented by spermatogonia, primary and secondary spermatocytes, spermatids and sperms. The sperms were situated in the lumen of the tubule and facing toward the Sertoli cells. Sertoli cells are the nutritive cells and they rested on the basement membrane of the tubule (Fig. 1).

Testes of rats treated with tetramethrin for two weeks revealed that the connective tissue stroma appeared loosely packed around the seminiferous tubules. The number of spermatogenic cells was reduced and many spermatocytes were exfoliated in the lumen of some tubules (Fig. 2). These pathological changes were exaggerated in rats treated with tetramethrin for 4 weeks. In these specimens the intertubular tissue became hyalinized and thickened and Leydig cells were deformed. The spermatogenic cells were markedly reduced and the majority of the spermatocytes and spermatids became degenerated. A large vacuoles appeared in the tubules which contained a lesser number of abnormaly distributed sperms (Fig. 3).

Testes of rats treated with tetramethrin for 6 weeks revealed significant loss of the spermatogenic cells especially spermatides and spermatocytes. The sperm bundles were degenerated in most of the tubules and were completely absent in others. The connective tissue stroma were highly degenerated leaving large vacuoles between the tubules (Fig. 4). Leydig cells were degenerated and poorly developed in the treated testis (Fig. 5).

Discussion

Results obtained in the present study showed that tetramethrin caused various histological changes in the testes in addition to significant loss in testes weight and reduction in diameter of the seminiferous tubules. These changes indicated that

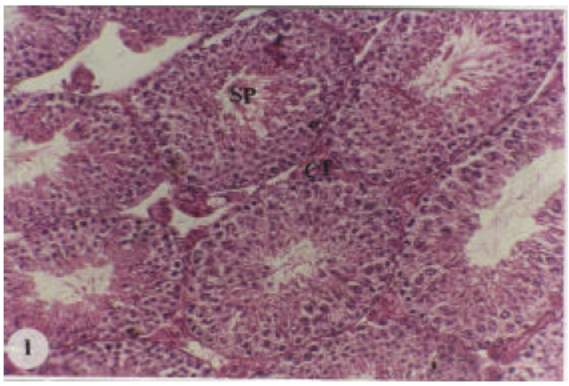

Fig. 1: A photomicrograph of a section in the testis of a control rat showing seminiferous tubules with normal arrangement of spermatogenic cells, CT: connective tissue stroma; SP: sperm bundles, X 120

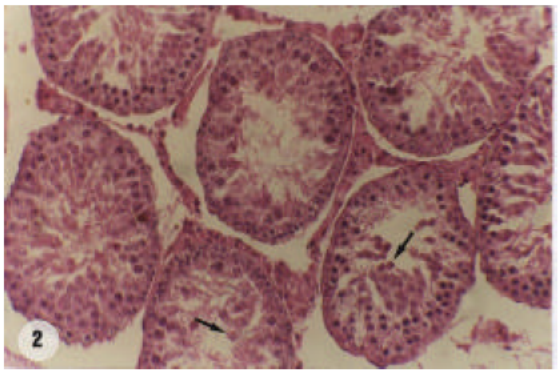

Fig. 2: A photomicrograph of a section in testis of a rat treated with tetramethrin for 2 weeks showing exfoliated spermatocytes (arrows) in the lumen of the tubules, X 120

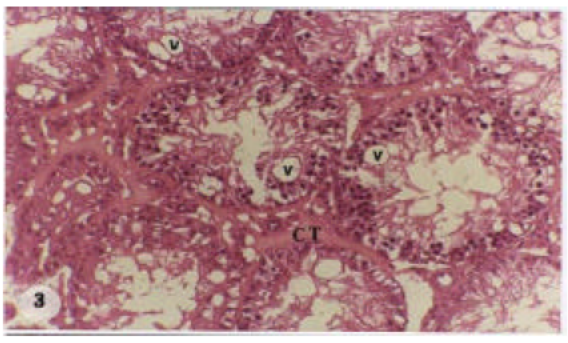

Fig. 3: A photomicrograph of a section in the testis of a rat treated with tetramethrin for 4 weeks showing abnormal seminiferous tubules with many vacuoles (V) and thickened intertubular tissue (CT), X120

tetramethrin inhibited spermatogenesis. These results are similar to those obtained by Alhazza and Bashandy (1998) who observed that inhalation of the pyrethroid insecticide "Pif

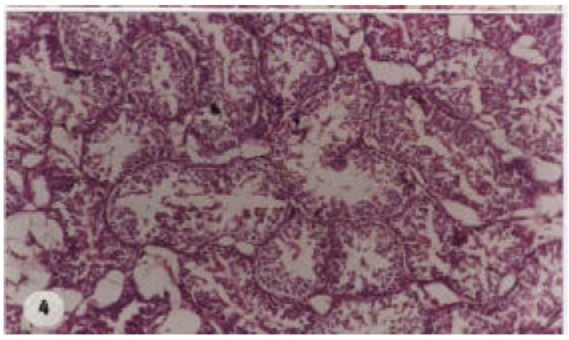

Fig. 4: A photomicrograph of a section in the testis of a rat treated with tetramethrin for 8 weeks, X 160

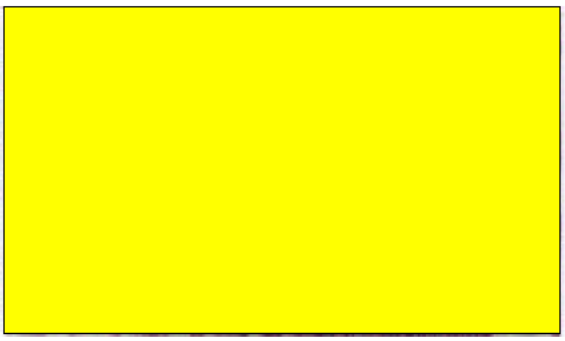

Fig. 5: Enlarged seminiferous tubule of the previous section showing marked reduction of spermatogenic cells and degenerated Leydig cells (arrows), X 300

Paf" which contain permethrin caused deformation of Leydig cells, pyknosis of spermatogonia, degeneration of spermatogenic layers and swelling of fibrocytes in the testes of rats. Moreover, the sperm motility and count of the insecticide-treated animals were significantly less than that of control.

The effect of pyrethroid insecticides on male reproduction is not clear. However, several other insecticides proved to injure and deteriorate the tests of different animals. Dikshith and Datta (1972a) reported that intracellular injection of lindane produced hypertrophic and atrophic changes in the testis of rats, whereas endrin did not induce atrophy of the testis. A single intraperitoneal injection of ethyl parathion, methyl parathion and DDT induced degenerative cellular changes in the seminiferous tubules of rats (Dikshith and Datta, 1972b). Such changes in spermatogenic cells included necrosis, karyopyknosis, vacuolation of the cytoplasm and formation of multinucleated giant cells.

Following oral treatment of mice with dichlorvos, significant testicular histopathology such as degeneration of seminiferous tubules and disappearance of spermatozoa and spermatides was observed (Krause and Homola, 1974). Feeding mature male quail with the chlorinated insecticide, Kepone had produced oedematous testes with highly dilated seminiferous tubules and reduced the germinal epithelium(Eroschenko and Wilson, 1975). El-Samannody *et al.* (1986) found that injection of kepone into mice has resulted in decreased spermatogenic layers in the seminiferous tubules. Moussa and Abdel-Hafez (1982) reported that feeding guinea pigs with dimethoate induced degenerative effects in the testes. They

added that dimethoate with the dose given and treatment periods applied, caused the inhibition of the normal function of the testis to a large extent, but did not destroy completely the germinal epithelium. Saleh (1996) found that treating mice with the carbamate insecticide, lannate, caused many histological changes in the testis together with arrest of spermatogenesis.

Hormonal abnormalities due to exposure to insecticides were studied by many investigators Dunnick *et al*. 1984, Ray and cremer, 1978 (Kelce *et al*., 1990). The role played by androgenic steroids such as testosterone in spermatogenesis is well proved (Steinberger *et al*., 1973). In the present work, it is speculated that tetramethrin may be responsible for inhibition of spermatogenesis in the rats through suppression of testicular androgenic activity. This hypothesis may be supported by the finding that Leydig cells which elaborate the male sex hormone, testosterone, were degenerated in the treated animals.

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