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Research Article

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The effects of titanium dioxide nanoparticles on pituitary-gonad axis in male mice

Yoosefi Mahdieh[1*], Shariat Sajad[2], Golabi Mahmoudreza[2], Safaei Mahsa[2], Heydari Negin[2], Kaji Andishe[2] and Modaresi Mehrdad[3]

[1]*Department of Basic Sciences, Faculty of Veterinary Medicine, Ferdowsi University of Mashhad, Iran*
[2]*Research Center of Ostad-Taaher, Department of Education and Training, Shahreza, Iran*
[3]*Department of Animal Science, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran*

ABSTRACT

Titanium dioxide is a nanoparticle which is widely used as a sanitary compound to control microorganisms. Small size of this particle, chemical compound and high reactivity may cause potential risks for human or environment. This research was carried out to study the effects of titanium dioxide nanoparticles on pituitary-testicular axis of male Syrian mice. Forty mature male mice were divided in four groups. Control group, placebo group did not receive any treatment except ordinary food and water. Experimental groups received 10 and 100 ppm of titanium dioxide nanoparticles via gavage for 14days. At the end of the experiment, mice were anesthetized with chloroform, blood samples were taken from the heart and LH, FSH and testosterone hormones were measured using standard tests. Results showed that LH, FSH, and testosterone concentrations were decreased significantly in proportion to control group ($p<0.05$).Therefore, titanium dioxide reduces pituitary-testicular axis hormones and decreases reproductive potential of male sex.

Keywords: titanium dioxide, mice, sexual hormones

INTRODUCTION

Endocrine glands produce hormones. Hormones are chemical matters which are extant in blood and control processes of other body parts. These processes are metabolism(chemical reactions that occur constantly in the body), response to stress, and growth and development of sexual organs. This complex includes glands and other hormone producer cells. Glands like pituitary, adrenal and thyroid are the organs which produce only specific hormones. Other organs and tissues such as ovaries, testes, heart, and kidneys have also hormone producer cells [1].

Testes are placed in a bag of skin and muscles known as scrotum. They produce sperm and male sexual hormone (testosterone) which causes the onset of puberty and secondary sexual specifics such as facial hairs [2].

Recent studies have shown that titanium dioxide (TiO_2) is a nanoparticle which is widely used to control microorganisms and pathogens in health products and also in a wide range of applications and commercial uses [3].

There are many evidences that unique physicochemical properties of TiO_2 such as small size, surface increase per mass unit, chemical composition, surface structure, formation and accumulation, and high reactivity can cause potential risks for human and environment. This matter can enter the body via various was including inhalation, ingestion or injection and affect cells and cell components such as proteins, fats balances and cells performance and cause cell toxicity[3,4]. Due to increasing use of titanium dioxide nanoparticle and no study about its side effects, this research was carried out to study the effects of titanium dioxide nanoparticles on pituitary-testicular axis of male mice.

EXPERIMENTAL SECTION

Forty mature male mice (Wistar race) from the age of four to five weeks and weight of 25 to 30 grams were used in this study. Mice were kept for seven days under 25-28℃ temperature, 12 hours of darkness and 12 hours of light, 25-30% humidity and free access to food and water to adapt to environment. After that, mice were divided in four groups: control group, placebo group did not receive any treatment except food and water. Experimental groups received 10 and 100 ppm of titanium dioxide nanoparticles via gavage for 14days.

Blood sample were taken directly from the heart using 10 cc syringes. Blood was poured in test tube impregnated with the anticoagulant heparin and desired parameters were measured. Obtained data were analyzed to determine the effects of titanium dioxide on blood proteins.

The experimental design was a completely randomized design. Data were analyzed by SPSS (18) software.

RESULTS AND DISCUSSION

FSH concentration was decreased significantly in 100 and 100 ppm groups in proportion to control group ($p<0.05$).

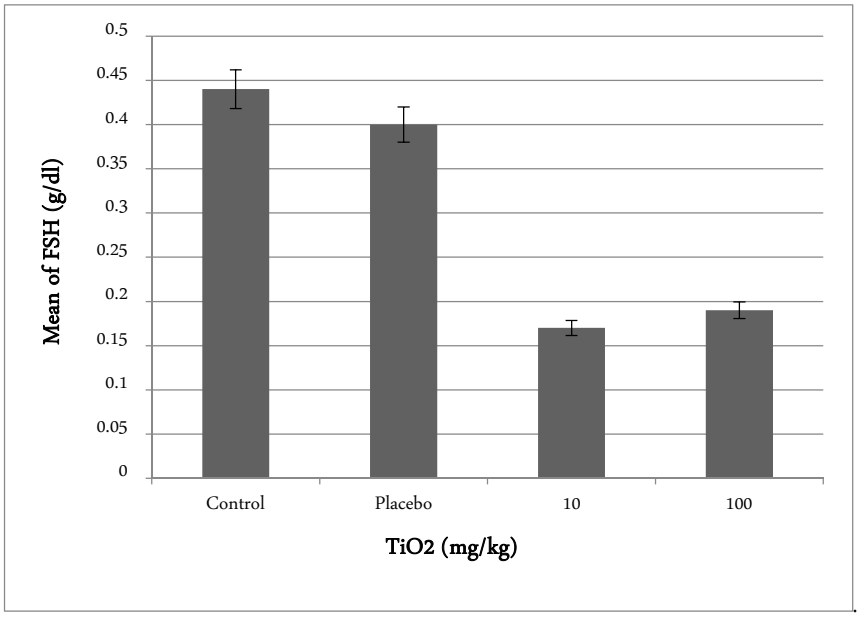

Figure1. FSH concentration in treatment groups

LH concentrations of experimental groups were decreased significantly in proportion to control group (figure 2).

Testosterone hormone was also decreased in 100 and 100 ppm groups significantly in proportion to control group ($P<0.05$).

Gonadotropin releasing hormone from hypothalamus affects front pituitary and causes increase in FSH and LH secretion and therefore stimulates testosterone secretion [1]. According to results, simultaneous reduction in serum levels of testosterone and LH and FSH hormones indicates the effect of titanium dioxide on hypothalamus-testicular axis. This can be due to reduction in ability of LH and FSH secretion from front pituitary and following decrease in testosterone level of serum. Thereby, reducing the level of testosterone in this study was a secondary response to gonadal stimulating hormones [2].

Regulatory feedback mechanism of FSH is not enforced only by testis steroids but inhibin, activin, and follistatin play also roles in FSH adjustment by central effect on GnRH production. Significant decrease in FSH amount can be due to modulatory effects of these parameters [5, 6].

Reduction in serum testosterone concentration by decrease in LH amount is expected and therefore titanium dioxide nanoparticle have reduced testosterone by destroying Interstitial cells(leydig cells) and somniferous tubes epithelium[7,8].

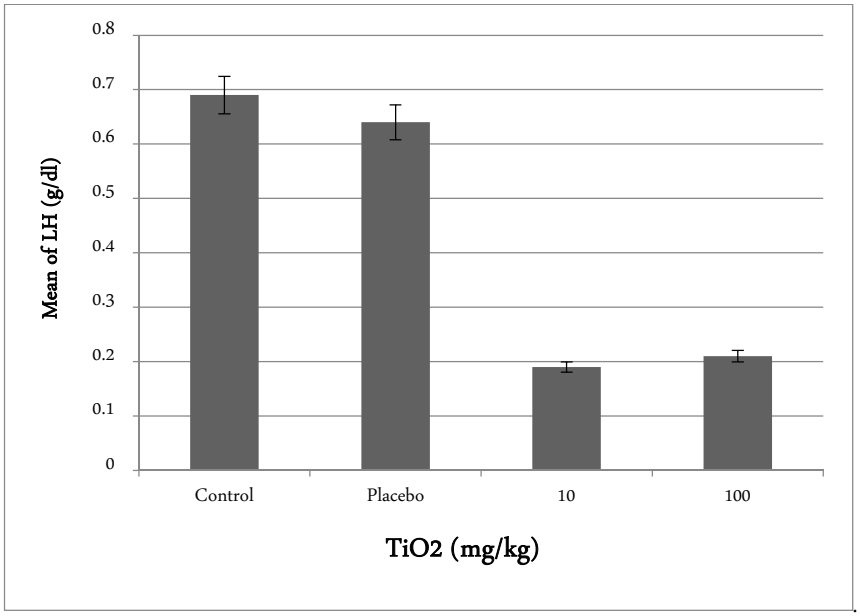

Figure2. LH concentration in treatment groups

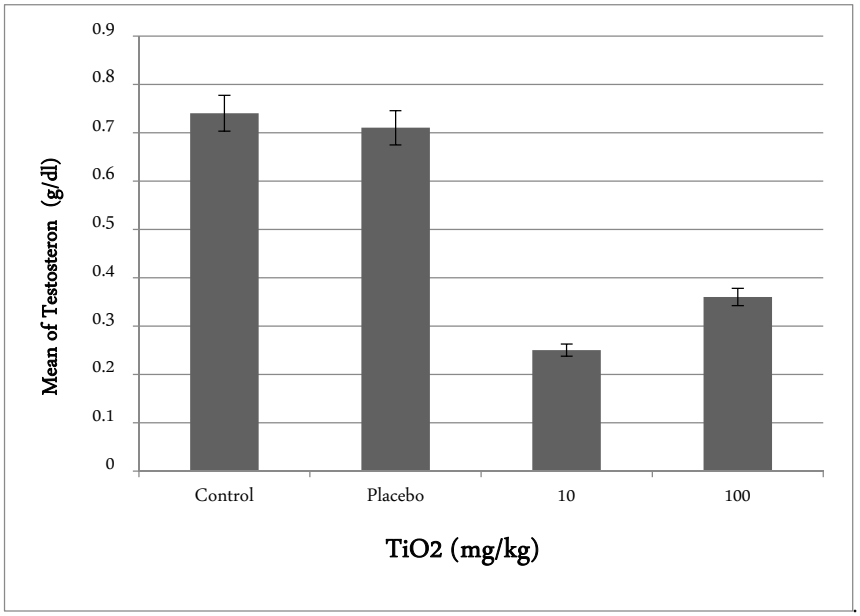

Figure3. Testosterone concentration in treatment groups

CONCLUSION

This research showed that to titanium oxide nanoparticles reduced the serum levels of front pituitary gonadotropins by affecting the pituitary- testicular axis. Also, reduction in LH and FSH amounts caused decline in testosterone level.

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