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The effects of titanium dioxide nanoparticles on sexual hormone sin female mice

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ABSTRACT

Titanium dioxide is a nanoparticle which is used widely in order to control microorganisms and pathogens in health products and in a wide range of applications and commercial use. Current study was carried out to investigate the effects of titanium dioxide on reproductive hormones in female mice. Forty female mice were divided in to four groups: control, placebo, and two experimental groups. Placebo group did not receive anything except water and standard food. Experimental groups received 10 and 100 ppm of titanium dioxide in water. After 14 days, blood samples were taken and estrogen, progesterone, FSH and LH amounts were measured. Results showed that 10 and 100 ppm amounts reduced the amounts of FSH, LH, estradiol and progesterone significantly. Therefore, titanium dioxide can affect reproductive activities by changing pituitary gonadal axis and has negative effects on reproductive potential of female sex.

Keywords: titanium dioxide, female sexual hormones, mice

INTRODUCTION

In recent decades, researches are focused on materials behavior in atom scale. In most scientific and engineering categories effects of nanotechnology can be found. The goal of nanoscience is designing and constructing new applicable materials. Nowadays nano is a wide science so that chemists, physicists, physicians, engineers,financial managers and environmentalistswork together to improve society through nanoscience [1].

Materials in nano scale such as nano pipes and nano wires show amazing properties. Improving these properties in nanoscale and using them in macro scale has become a real challenge [2]. For instance, mechanical properties of polymers and metallic materials are improved by strengthening using nanoparticles. On the other hand,surfaces hardness is improved by covering them using a thin film [1].

Nanoparticles of dioxide titanium have three phases of anatase, rutile, and brookitewhich two first phases are more important due to photocalysticproperties. Breaking of atomic bonds of non-degradable organic materials and converting them into less harmful materials as a result of sun and ultraviolent light exposure in semiconductors such as metal oxides is called photocalystic action [3].

Producing industrial filtration machines of polluted water and air is from titanium dioxide photocalystic properties. Several researches have shown that photocalystic action of this material is a function of the crystalline phase and grain size [2].

Also, titanium dioxide 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 use [4].

There are many evidences that unique physicochemical properties of TiO2 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 [5].

Cytotoxic effects of TiO_2 depend on its physicochemical properties especially the size. Smaller particles cause more damage in proportion to larger ones. Considering the use of TiO_2 nanoparticle in recent centuries in different sciences this research was done to study the effects of titanium dioxide nanoparticles on female mice sexual hormones.

Female sexual hormones system includes:
1. A hypothalamic releasing hormone known as gonadotropin releasing hormone (GnRH).

2. Anterior pituitary hormones known as Follicle stimulating hormone (FSH) and luteinizing hormone (LH) which are secreted in response to GnRH secretion from hypothalamus.

3. Ovary hormones: estrogen and progesterone hormones which are secreted in response to two female sexual hormones from front pituitary. These hormones are not secreted constantly along during the menstrual cycle and have different amounts in various times of the cycle [6].

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-gonad axis of female mice.

MATERIALS AND METHODS

Forty male mature mice (Wistar race) from the age of two weeks and the weight of 30± 3 gram were divided into four groups: control group, placebo group, and 10 ppm and 100 ppm doses of nanoparticles per body weight.

Animals were kept in propylene cages which their floors were covered by sawdust under controlled condition (20-25℃ temperature, 25-30% relative humidity, 12 hours darkness and 12 hours light, with free access to water and food).

Mice were kept for seven days before enforcing treatments to adapt to environment. Experimental groups received 10 ppm and 100 ppm doses of nanoparticles orally via gavage for two weeks.

To prepare desire doses, nanoparticles with the size of 20nanometer were prepared from Iranian nanomaterial Pioneers Company and were solved in ordinary water for 15 minutes using ultrasonic machine.

After the end of the period, chemicals were anesthetized using chloroform and blood samples were taken from the heart using 5 cc syringes. Ethics of international pain society for laboratory animals were considered. 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 female hormones.

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

RESULTS AND DISCUSSION

According to results, FSH, estradiol, LH and progesterone amounts were significantly reduced ($P<0.05$) by 10 and 100 ppm closes of titanium dioxide.

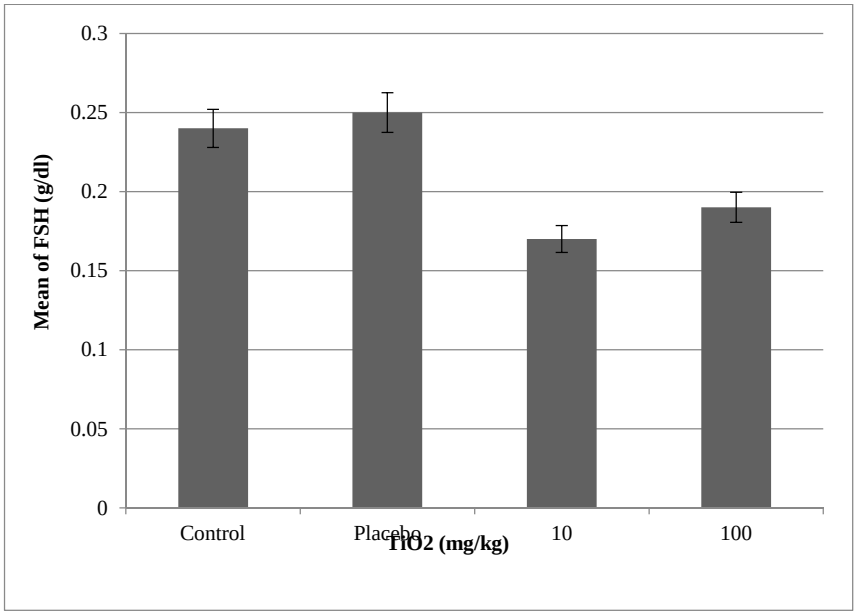

Figure1. Mean comparison of FSH amount in treatment groups

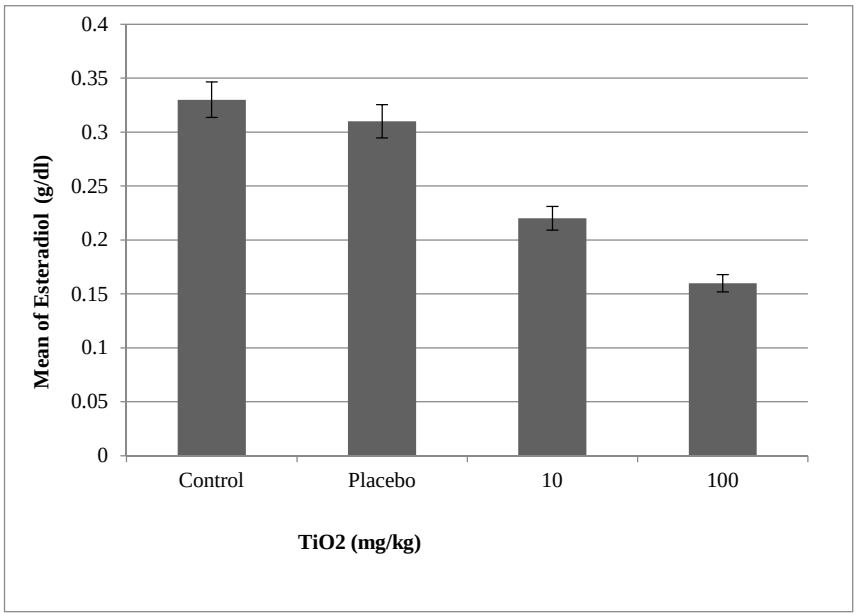

Figure 2. Mean comparison of estradiol amount in treatment groups

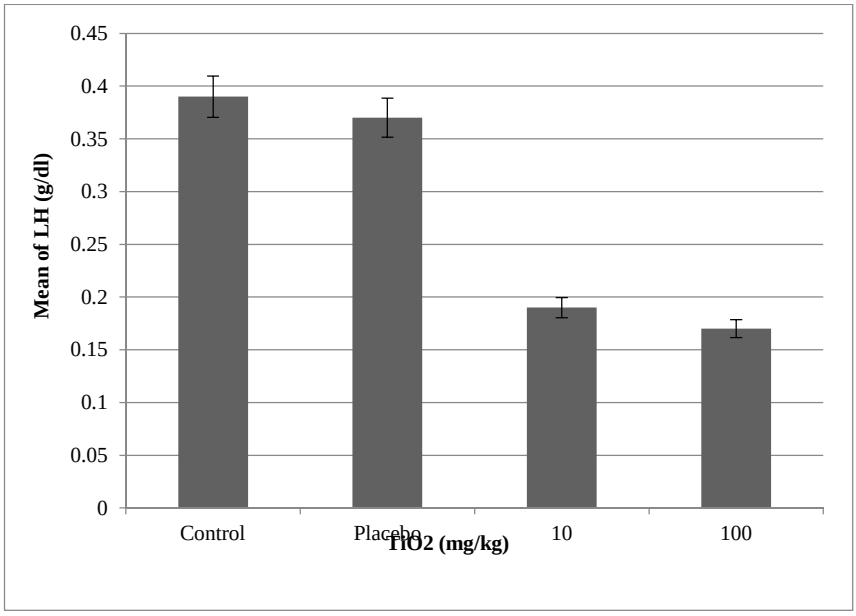

Figure 3. Mean comparison of LH amount in treatment groups

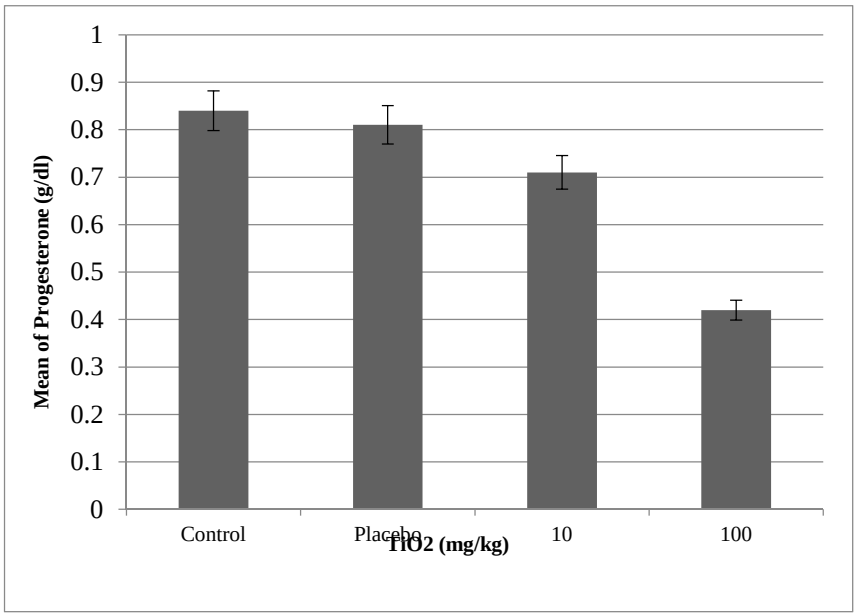

Figure 4. Mean comparison of progesterone amount in treatment groups

Unfavorableenvironmental conditions will lead to problems in the survival of generations by affecting reproduction physiology.

The main path of regulating reproductive functions is hypothalamus-pituitary-gonadal axis (HPG). This axis is under feedback control and regulates sexual activities of human and other mammals.Secretion of releasing hormones (GnRH) from hypothalamus stimulates front pituitary and cause FSH and LH gonadotropins. Follicle granulosa cells are in charge of producing estrogen in ovaries[6] (Castanedaet al.2009). Therefore, female reproduction system acts as a coherent system in this way and any environmental factor can affect this performance.

Considering the results, it can be concluded that estrogen depends on the number of follicles and the estradiol released from the mature follicles. FSH reduction in experimental groups can also be an important factor in reducing estrogen [7].

Progesterone amounts of experimental groups were reduced in proportion to control group and this reduction is tightly related to LH concentration.

Considering the obtained results we can conclude that estrogen decreasing is mostly depend on the number of follicles and stradioles released from mature follicles [8]. Yet, FSH decreasing in 10 and 100 groups can be important factor in estrogen decreasing.

According to results, titanium dioxide nanoparticle is able to affect reproduction activities by affecting pituitary-gonadal axis and has negative effects on female sexual potential.

CONCLUSION

According to results, titanium dioxide can affect reproductive activities by decreasing pituitary gonadal axis and has negative effects on reproductive potential of female sex.

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