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Research Article

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The effects of titanium dioxide nanoparticles on thyroid hormones in mice

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ABSTRACT

Nanoparticles have interactions with biological components and thereby affect thyroid gland. The goal of this research was studying the effects of titanium dioxide nanoparticles on thyroid performance. Forty mature Syrian mice were divided in four groups. Control group, placebo group received only standard food and water whereas experimental groups received 10 and 100 ppm of titanium dioxide in water also. After 14 days, blood samples were taken and thyroid hormones were measured. Results showed significant reduction in T_4 and TSH amount of all groups which confirm that titanium dioxide is a strong controller of thyroid hormones and induces hypothyroidism.

Keywords: titanium dioxide nanoparticles, TSH, T_4, T_3

INTRODUCTION

Nanoparticles of titanium dioxide can be used in production of painting colors, cosmetics, ceramics, photocalysts, water and sewage filtration, gas filtration, and many other industries because of their unique specifics [1].

Proposed theories about probable dangers of nanotechnology threats development of this technology unless correct impartially information about the nature of dangers and avoiding them be released [2].

Toxicology of nanomaterials will play an important role in developing safe and sustainable nanotechnology. We have little knowledge of toxic effects of nanomaterials on environment and human. But, due to their specifics, interaction of these materials with biological components and significant effects on behavior and specifics of macromolecules, cells and body of alive creatures are probable[3].

Nano materials have numerous unique specifics in proportion to other chemical ordinary materials due to high diversity [4].

Physical specifics of nanoparticles including size, morphology, solubility and chemical properties including compound and chemical structure of cover are important; type and amount of biological effect will vary by changes in any specific[5].

Also, other factors such as surface to volume ratio, phase transition, chemical stability and tend to form clumps can be important [4].

Thyroid hormones (T_3 and T_4) are dividing from thyrosin amino acid. About 95% of thyroid secreting hormones are T4 (thyroxin) whereas T3 plays the main role. The main part of T3 is obtained from converting T4 to T3 in peripheral tissues like liver, kidney and placentum. Some tissues like brain and hypophysis can also convert T4 to T3 but obtained hormone cannot be entered to blood and remains there. On the whole, 80% of blood's T_3 is made in

liver and 20% in thyroid. Secreting thyroid stimulating hormone (TSH) controls releasing thyroid hormones. The amount of TSH secreting is also adjusted by level of thyroid hormones in blood. Thyrothropine releasing hormone (TRH) secreted from hypothalamus adjusts TSH releasing from hypophysis some how [6].

On the whole, in view of different applications of nanomaterials in various industries, and theories about destructive effects of these particles on organisms, researches in this category are really important [5]. The goal of this research was studying the effects of titanium dioxide nanoparticles on thyroid performance.

EXPERIMENTAL SECTION

Forty mature mice (Wistar race) from the age of eight weeks and the weight of 25-30 g were selected. Samples were kept in propylene cages which their floor were covered with saw dust under 22±1℃ temperature, 12 hours of darkness and 12 hours of light, 60±10% humidity and free access to food and water. Mice were kept for two week to adapt to environment. After that, mice were divided in four groups:

Control group, placebo group received only standard food and water whereas experimental groups received 10 and 100 ppm of titanium dioxide in water also via gavage for 14 days.

To prepare the desired doses, titanium dioxide (20nanometer) was prepared (Iranian nanoparticles pioneers company) and dissolved in water under supersonic waves for 15 minutes. Blood samples were prepared from the heart using syringes and TSH, $T_3$and T_4 hormones were measured. Obtained data were analyzed using SPSS program. Duncan's multiple ranges test was used to compare means at 5% probability level.

RESULTS AND DISCUSSION

TSH amount of experimental groups were decreased significantly in proportion to control group ($P<0.05$).

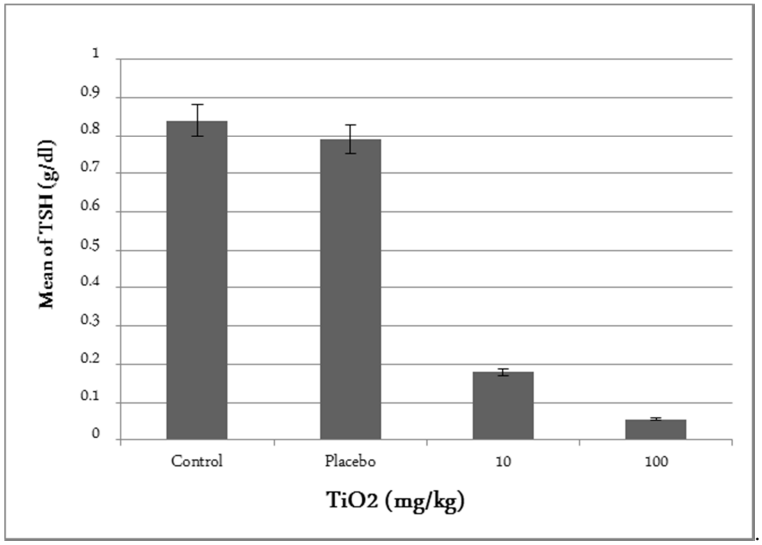

Figure1. Mean comparison of TSH in all groups

Also, T_4 amounts of 10 and 100 ppm groups were decreased significantly ($p<0.05$) in proportion to control group.

T_3concentrationwas not significant different in all treatment groups.

Nanoparticles pollution is an important problem of world now. In current study, toxicity of titanium dioxide nanoparticles was studied because of frequent use of this material in various industries.

It seems that titanium dioxide affects different actions of body and wide researches are needed to determine these effects. When nanoparticles are accumulated in a tissue, they may be absorbed by cells or not. In case of absorption, final replacement will be in lysosome or cytoplasm which will have real damages. Remaining in cytoplasm for some materials can cause direct damage or cell death [6].

This research was carried out to study the toxicity of nanomaterials on thyroid gland and T_4 and TSH hormones were selected among lots of this gland's hormones to study the thyroid performance. High concentrations of titanium oxide reduced these enzymes. Therefore, lower amount of these enzymes shows thyroid cell injuries.

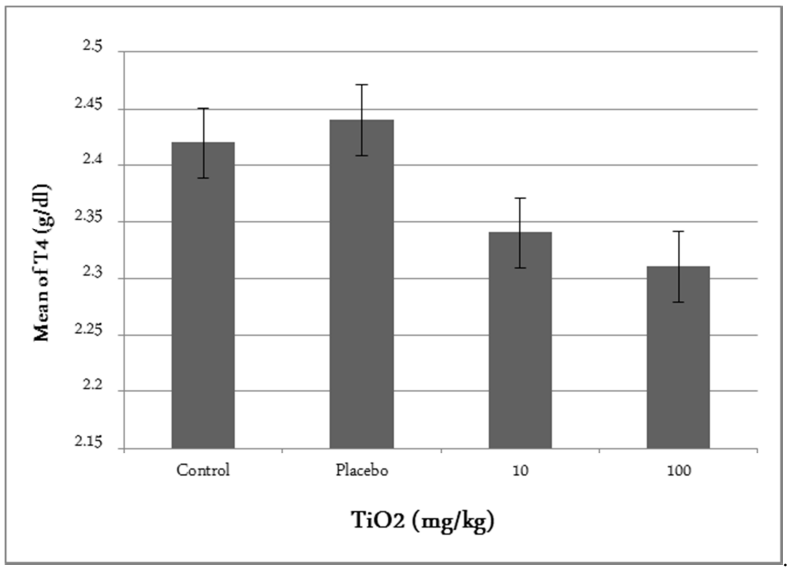

Figure2. Mean comparison of T_4 in all groups

Thyroid hormones affect development of blood cells. Most of the time there is an intermediate like a blood producing factor. Thyroid hormones stimulate blood producing by various strategies is which erythropoitin is the most important one [7]. Laboratory and human experiments have shown that these hormones are effective in hemoglobin synthesis and also in inverting embryo type of hemoglobin to mature type [8] so; reduction in T_4 can have negative effects on growth and physiological acts like blood producing among growth period.

In general, results of this study confirmed the toxicity of titanium dioxide nanoparticles. These nanoparticles in mentioned doses are strong controllers for thyroid hormones and induced hypothyroidism. More studies are proposed for predicting the effects of this material.

CONCLUSION

Thus, application of titanium dioxide nanoparticles in 10 and 100 ppm doses can have negative effects on TSH and T_4 in mice and it is suggested that this nanoparticle can be dangerous for thyroid health.

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REFERENCES

[1]Zhu Y, Eaton JW, Li C. *Plos One* **2012**; 7(11):e50607
[2] MitalGS,Manoj T. *Chinese SCi Bull*. **2011**; 56(16):1639-1657
[3]Weir A,Westerhoff P,FabriciusL,HristovskiK,von Goetz N. *Environ Sci Technol* **2012**;46(4):2242-50
[4] Liu S,Yang Z. *Methods Mol Biol*, **2013**;1028:135-45.
[5]Shi JW,ZhangF,ZhaoYL,Chai ZF. *Toxicology Letters*, **2006**; 161(2):115-23
[6]Aurthor JR, Beckett GJ. *Thyroid function. Rev Br Med Bull*,**1999**; 55: 658-68
[7]Antonijevic N, Nesovic M, Trbojevic R. *Med Pregl*, **1999**; 52(3-5): 136-40.
[8]Blum JW. Kunz P. *Acta Endocrinol*, **1989**; 98: 234- 240
[9]Fisher DA, Hoath S, Lakshmanan *J. Endocrinol Experiment*, **1982**; 16: 259-271