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website:- www.ultrascientist.org**Functional changes in the thyroid gland caused by the effect of cadmium in males of (*Mus musculus*) and the therapeutic role of selenium**

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Abstract

Three male *Mus musculus* groups were exposed to cadmium and selenium for a period of 45 days where is the first one was control.

The result showed that increase in the cadmium accumulation in the thyroid gland increase, it's weight and reduce the T4 hormone level wither the TSH level were increased. This study showed that Se can alleviated the effect.

Key words: cadmium, selenium, thyroid, thyroid hormones, *Mus musculus*.

Introduction

The thyroid gland is an endocrine gland that creates and secrete regulatory hormones such as thyroxine (T4) and triiodothyronine (T3), which are synthesized in the follicular cells. These hormones are necessary to increase metabolism in most cells. Meeker, *et al.*,¹.

Congenital cells of calcitonin are also excreted in connective tissues that play an important role in regulating calcium and phosphorus metabolism. Luo and Hendryx². Swoucki,³. Cadmium is among 126 priority pollutants and has a strong tendency to accumulate in various devices, including the thyroid gland. Chen, *et al.*,⁴. Cadmium affects kidney, skeletal, and respiratory systems and is classified among the first group of carcinogens by the International Agency for Research on Cancer. Järup and Åkesson⁵.

Exposure to cadmium results in many cellular or metabolic effects in a variety of body tissues, and

reduced growth rates. Hill, *et al.*,⁶ atrophy and paralysis in the testis. Parizek,⁷ and kidney damage. Axelsson and Pistcator⁸. and weak function liver and pancreas. Rastogi and Singhal,⁹. and the thyroid gland. Nishiyama and Takata,¹⁰. Pilet, *et al.*,¹¹.

The endocrine system has been found to be affected by cadmium, especially the thyroid gland, pituitary gland, pancreas and testicles. Gupta, and Kar,¹². However, it was found that the adrenal gland has a tendency to accumulate more cadmium than any other endocrine. Killmer,¹³.

Many studies showed that cadmium can accumulate in the thyroid gland causing increase in its weight and increases the TSH level while T4 may be reduced. Hammouda, *et al.*,¹⁴.

Cadmium can also be a major contributor to autoimmune disease in the thyroid gland. Nishiyama and Takata,¹⁰.

In animal studies, cadmium was associated with lower levels of T4 in the serum and has been suggested to enter it in the removal of iodine. Hammouda, *et al.*,¹⁴. Mori,¹⁵.

Selenium treatment partially protects the reduction of cadmium in the T4 level in the blood, by maintaining the normal weight of the thyroid gland and by reducing the concentration of cadmium in the thyroid gland. Hammouda, *et al.*,¹⁴.

Studies indicate the devastating effect of heavy metals on impaired thyroid function and the need for further studies to elucidate the mechanism of action. Darras,¹⁶.

Materials and Methods

Experimental Design:

The experiment was conducted over 45 days, Thirty of the Male *Mus musculus* was used, which weighs 100 ± 15 g initial body weight, and was modified for two weeks before the start of the experiment in private cages, it was well ventilated, And under standard laboratory conditions.

The lighting period was 14 hours to 10 hours and the temperature was 25 ± 1 ° C.

They were divided into three groups, and the first group was the control group, it consists of 10 mice without any treatment.

The second group consisted of 10 mice and treated with cadmium at a rate of 100 ppm.

The third group was treated with cadmium 100 ppm and selenium 0.1 ppm.

Assay for Cd Concentration in Thyroid:

The concentration of cadmium in the thyroid was assessed by method. Current,¹⁷. and Using a device Inductively Coupled Plasma Mass Spectrometry (ICP-MS).

Thyroid was digested with nitric acid at 200°C for 25 minutes, and the volume was then adjusted to 200 ml with deionized water.

Hormone Analysis :

Using commercially available T4-RIA- kit and TSH RIA-kit the T4 and TSH serum levels were measured radio immunologically All assays were performed in the Pollution Research Laboratory.

Statistical Analysis :

Data were analyzed using IBM – SPSS (Statistical Package for the Social Sciences) version 22. One-way analysis of variance (ANOVA) was used for treatments to visualize the interactions effects. The level of significance is the standard.

Results

Body Weight Gain :

In Figure 1. The body weight gains of mice receiving Cd alone and supplemented with Se during the experimental period were similar to that noted in the control group.

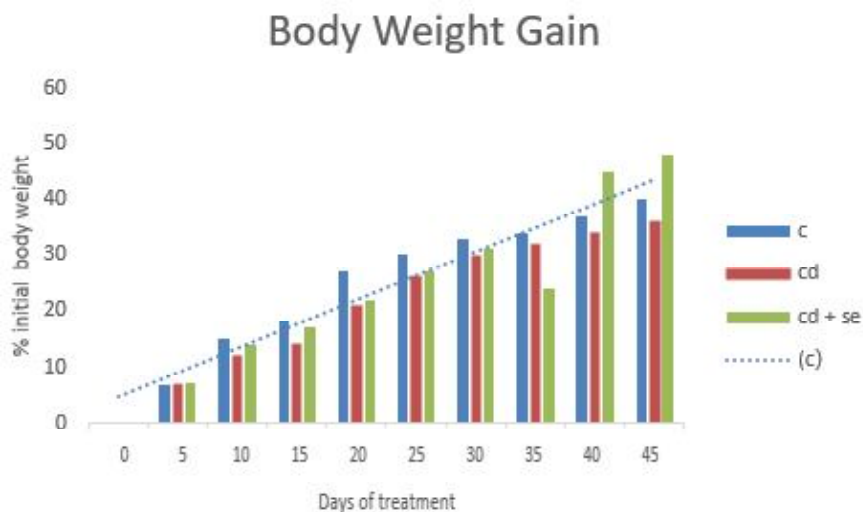


Figure 1. Shown the Body weight gains in control (C) and mice exposed for 45 days to cadmium (Cd, 100 ppm Cd), cadmium + selenium (Cd + Se, 100 ppm Cd + 0.1 ppm Se). Means from ten animals in each group.

Thyroid Weight:

In Figure 2. shown the Relative thyroid weight has significantly decreased ($p < 0.02$) in Cd-exposed mice as compared to control mice. Se supply had no significant effect on the Cd-induced decrease in the Relative thyroid weight.

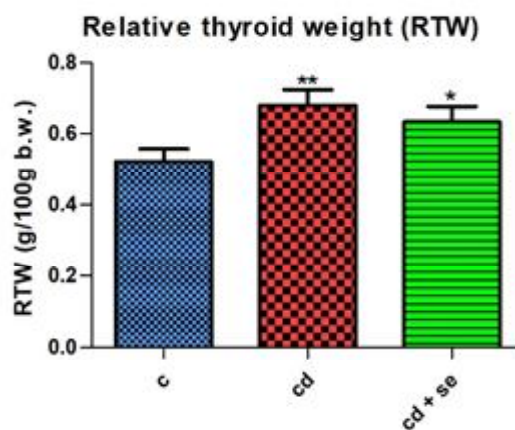


Figure 2. shown the Relative thyroid weight of control (C) and mice exposed for 45 days to cadmium (Cd, 100 ppm Cd), cadmium + selenium (Cd + Se, 100 ppm Cd + 0.1 ppm Se). Means \pm SE from ten mice in each group. Significance Means: * $p < 0.05$; ** $p < 0.01$.

Thyroid Cd Concentration :

In Figure 3. There was a significant increase in cd content in the thyroid gland in the Cd-exposed group compared to the control mice, and there were no significant differences between the concentration of Cd and Se, However, a significant reduction in Cd concentration in the thyroid gland was detected in the Cd and Se group compared with the Cd-treated group.

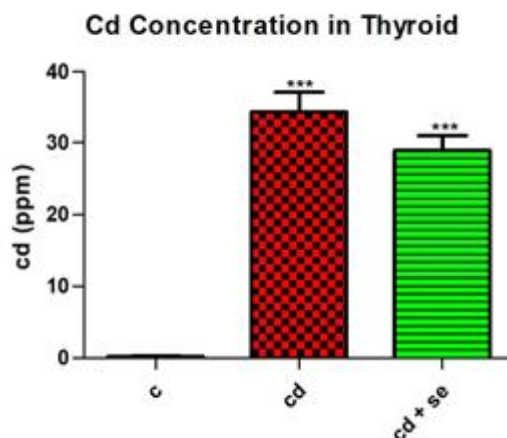


Figure 3. As shown the Cadmium concentrations in the thyroid control (C) and mice exposed for 45 days to cadmium (200 ppm Cd), cadmium + selenium (100 ppm Cd + 0.1 ppm Se). Means \pm SE from ten animals in each group. Significance Means: *** $p < 0.0001$.

Serum Hormone Levels :

In Figure 4. The treatment of Cd-exposed mice alone decreased significantly ($p < 0.0001$) the serum T4 level, Serum T4 levels of the Cd + Se ($p < 0.0001$) group were significantly higher in comparison to the Cd-exposed mice but significantly ($p < 0.0001$) lower when compared with control mice.

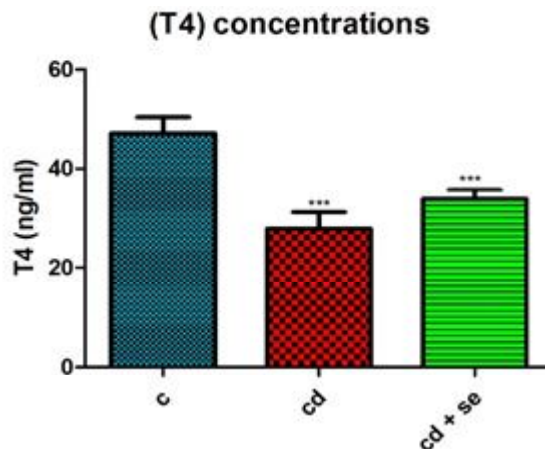


Figure 4. As shown the Serum tetra-iodothyronine (T4) concentrations in control (C) and rats exposed for 45 days to cadmium (Cd, 100 ppm Cd), cadmium + selenium (Cd + Se, 100 ppm Cd + 0.1 ppm Se). Means \pm SE from ten animals in each group. Significance Means: *** $p < 0.0001$.

In Figure 5. As shown the serum TSH level was significantly increased ($p < 0.01$) in Cd-exposed rats as compared to control mice. The treatment of Cd-exposed rats with Se had no significant effect on the Cd-induced increase in the serum TSH level.

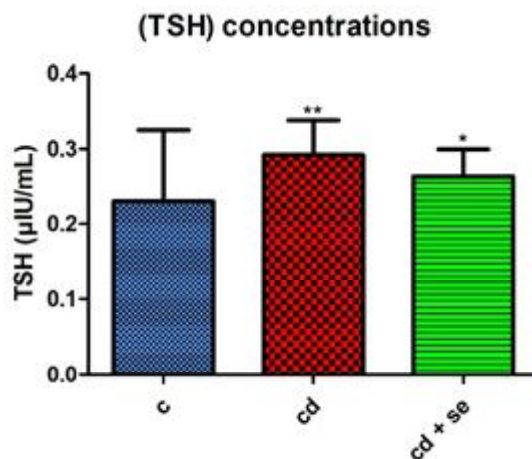


Figure 5. shown the Serum thyroid-stimulating hormone (TSH) concentrations in control (C) and mice exposed for 45 days to cadmium (Cd, 100 ppm Cd), cadmium + selenium (Cd + Se, 100 ppm Cd + 0.1 ppm Se). Means \pm SE from ten animals in each group. Significance means * $p < 0.05$; ** $p < 0.01$.

Discussion

This study shows that, selenium reduces the effect of cadmium in thyroid gland, leading to it's dysfunction. Results also showed that Cd accumulation in the thyroid gland, leading to an increase in it's weight. Similar result were shown in the *Mus musculus*. Piłat-Marcinkiewicz,¹⁸ were observed in the follicles thyroid gland increase in the size. The mice were treated with (100 ppm, Cd and 0.1 ppm, Se) For 45 days showed an increase in body weight, this may be because the mixture of Cd and Se can cause wattle. Hammouda, *et al.*,¹⁴. The results indicate that cadmium has a significant effect on concentrations of thyroid hormones in the serum which is similar to the study of. Goyer, *et al.*,¹⁹. The effect may be because of it can be readily absorbed and accumulated in tissue for a long time

The results of this study showed a significant decrease in the level of (T4) in the group treated with cadmium compared to control group. The decrease in the hormone level may be because due to Cd interference with the pituitary regulation of thyroid hormones production and secretion, in this organelle might disturb the oxidative phosphorylation and loss it's energy supply caused inhibition of synthesis and release of thyroid hormones. Kelly,²⁰.

The increase in (TSH) level is probably because of the decrease of serum T4 level, and a tendency of increased TSH concentration in serum may indicate the effects of cadmium on pituitary regulation of production and secretion of thyroid hormones and this corresponds to a study. Piłat-Marcinkiewicz, *et al.*,¹⁸. and the results were also consistent with the study. Yousif and Asma,²¹. as cadmium inhibits the production of thyroid hormones.

This study deals with the role of selenium in mitigating the effect of cadmium on Thyroid function of mice, in many studies Se has been shown to have an effective effect against the toxicity caused by cadmium.

Shamberger,²².

Selenium is an essential microelement with antioxidant properties that bind cadmium and other toxic elements such as mercury or arsenic. Lazarus,²³. In conclusion, exposure to cadmium caused a number of toxic damages to thyroid gland It is recommended to link cadmium-producing industries with appropriate methods for waste disposal to reduce hazardous effects of heavy metals generally, and cadmium specifically. The combination of cadmium and selenium was effective in reducing the cumulative toxic effects of cadmium in serum hormones levels.

Further studies are recommended to determine the mechanism Se in reducing the toxic effects of cadmium and the other of heavy elements.

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