ROLE OF SOME NATURAL ANTIOXIDANTS AGAINST EFFECT OF CADMIUM IN THYROID GLAND

By
Omyma Kamel Radwan Abou Zeed
B.Sc.Science (Entomology-Chemistry), Ain Shams University, 1982

A Thesis Submitted in Partial Fulfillment
of
The Requirement the Master Degree
in
Environmental Sciences

Department of Environmental Basic Sciences
Institute of Environmental Studies & Research
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Omyma Kamel Radwan.

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LIST OF ABBREVIATIONS

- 5`D-I Hepatic 5`-monodeiodinase.
- CAT Catalase.
- CMC Caboxymethylcellulose.
- CNS Central nervous system.
- EPA Environmental Protection Agency.
- GSH Reduced glutathione.
- GSH-Px Glutathione peroxidase.
- GSH-R Glutathione reductase.
- GSSG Oxidized glutathione.
- LPO Lipid peroxidation.
- MDA Malondialdhyde.
- MT Metallothionine.
- ROS Reactive oxygen species.
- Se Selenium.
- SOD Superoxide dismutase.
- TBARS Thiobarbituric acid reactive substances.
- TSH Thyroid stimulating hormone.

ABSTRACT

Role of some natural antioxidants against effect of cadmium in thyroid gland; Omyma Kamel Radwan Abou Zeed; M.Sc. Thesis, Institute of Environmental Studies and Research; Basic Environmental Sciences.

Cadmium (Cd) is a very toxic heavy metal and an important environmental pollutant in the soil, water, air, food and in cigarette smoke. Cd causes poisoning and oxidative damage in various tissues. Thyroid hormones are associated with the oxidation status of the organism. The present study aimed to investigate the oxidant and antioxidant status in cadmium-induced thyroid dysfunction in rats and examine the effect of natural antioxidants (vitamin E & C and taurine) supplementation on this experimental model, which comprised two separate experiments. The first one was designed to study the prophylactic effect of the tested antioxidants against cadmium toxicity in plasma, liver and thyroid tissues of adult female albino rats. The second experiment was designed to study the curative effect of the tested antioxidants on Cd intoxicated rats. The first experiment was extended for 30 days. Animals were divided into six groups. G1, normal control group. G2, vitamin control group that received daily 5, 10 mg/kg of vit. E & C respectively. G3, taurine control group that received daily 500 mg/kg of taurine. G4, Cd control group that received daily 15 mg/kg of $CdCl_2$. G5, vitamin prophylactic group that received vit. E & C one week before Cd administration and along with Cd for 30 days. G6, taurine prophylactic group that received taurine one week before Cd administration and along with Cd for 30 days. In the second experiment pretreated Cd intoxicated rats (for 30 days) were subdivided into three groups. G1, Cd control group that received stock diet without Cd administration. G2, vitamin treated group that received a combined dose of vitamin E & C. G3, taurine treated group that received taurine. The administration of the test compounds lasted for 15 days. The results showed that, plasma, liver and thyroid tissue lipid peroxide product MDA levels were increased while plasma, liver and thyroid reduced glutathione GSH and Superoxide dismutase SOD levels were decreased by Cd toxicity, inducing a state of oxidative stress. Plasma triiodothronine T_3 & thyroxine T_4 levels were decreased, while a slight increase in thyroid stimulating hormone TSH level, were induced by Cd toxicity, showing a state of hypothyroidism, which could be attenuated by supplementation of a combined dose of vit. E&C as well as taurine, showing amelioration in thyroid hormones levels, thyroid tissue and antioxidant status

(GSH&SOD), resulting in promotion of the thyroid activity, in addition to reducing LPO which diminished the oxidative stress. Based on these results, administration of a combined dose of vit. E&C as well as taurine daily for persons at high risk of Cd contamination is strongly recommended.

Key Words: Cadmium, vit. E, vit. C, taurine, thyroid gland, hypothyroidism, T_3, T_4, TSH, SOD, GSH, GSSG, MDA, antioxidants, oxidative stress, lipid peroxidation (LPO).

INTRODUCTION

Pollution of the environment with toxic metals has increased dramatically since the beginning of the industrial revolution. Humans interact with their environments on a daily basis and, as a consequence, they are exposed to a broad spectrum of pollutants. Among these pollutants cadmium (Cd) is considered as one of the most toxic substances in the environment due to its wide range of organ toxicity and long elimination half life amounted to 20-30 years **(Beytut *et al.*, 2003, Raquel *et al.*, 2006).** Cd is of particular concern because it accumulates in the human body and is linked with a number of health problems **(Kelly, 1999).** Accumulation of Cd in several organs induces systemic DNA damage. These organs protect themselves by inducting detoxifying mechanisms against hydrogen peroxides production such as induction of endogenous antioxidants in these organs **(Valverde *et al.*, 2000).** Studies showed that Cd accumulates in thyroid, kidney, liver and pancreas, all areas that seem to be involved in thyroid diseases **(Sato and Takizawa, 1992).**When cadmium is absorbed, it circulates in erythrocytes or bound to albumin. In the liver, it can induce and bind to metallothionine (MT) **(Lyn Patrick, 2003). Falnoga *et al.*, (2000)** found that Cd also accumulates in thyroid gland more than the most others areas of the body, indicating that Cd plays a pivotal role in thyroid function. Furthermore, **Blazka and Shaikh (1991)** reported that estradiol directly increases the accumulation of Cd in liver and kidney tissues, thus Cd accumulates in female tissues more than male tissues and have greater thyroid diseases. One of the basic mechanisms involved in Cd toxicity might be via production of reactive oxygen species (ROS) which are