PHYSIOLOGICAL STUDY TO EVALUATE THE ROLE OF ASTAXANTHIN ON THYROID HORMONES AND ANTIOXIDANTS AGAINST TOXICITY RELATED TO MANGANESE CHLORIDE IN MALE ALBINO RATS.

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Abstract: Manganese (Mn) is an essential trace metal and acts as cofactor in many cellular enzymes. But excessive concentration of the Mn is potentially toxic resulting in several disorders. Astaxanthin is a potent antioxidant with anti-inflammatory activity ,The present study was designed to evaluate the role of Astaxanthin in disorder causes by toxic effects of manganese chloride (MnCl2 .4H2 O) exposure on marker biochemical parameters, of thyroid gland and enzymatic antioxidant (Superoxide dismutase enzyme SOD, Catalase CAT , Glutathione GSH and Malondialdehyde MDA) in rats. Adult male rats were randomly divided into three groups. In group 1, the rats were treated with vehicle (1 ml distill water) and served as control. The rats in group 2 were treated with MnCl2(50 mg/kg b.wt./day)and Astaxanthin 50 mg/kg b.wt./day) for 30 days The results showed Serum levels of The thyroid hormones, 3,5,3′-triiodotyronine (T3) , and its precursor, namely the "prohormone" thyroxine (T4), significantly decreased in group 2 which treated with MnCl2, and thyroid stimulating hormone TSH increased but normal level T3,T4,TSH in G3 , and thyroid stimulating hormone TSH increased but normal level T3,T4,TSH in G3 . The results showed Serum levels of The (SOD,CAT, GSH) significantly decreased and while MDA increase in group 2 which treated with MnCl2 and Serum levels of The (SOD,CAT, GSH significantly increased and while MDA decrease in group 3 which treated with MnCl2+Astaxanthin. Taken this data suggest that MnCl2 exposure has adverse impact on the functions of thyroid gland, antioxidant level in serum and astaxanthin reduces the damage of thyroid gland caused by MnCl2 and scavenge free radicls by disrupting free-radical chain reaction.

Keywords: Astaxanthin , manganese chloride ,antioxidants , T3,T4.

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INTRODUCTION

Plants and some photosynthetic bacteria produce carotenoids, which are bioactive natural compounds. Many carotenoids participate directly in photosynthesis, whereas others protect the host from photooxidation and other damage [1].Astaxanthin is a carotenoid that has gotten a lot of attention recently. It's a red xanthophyll carotenoid that's mostly found in marine microbes and mammals [2, 3]. In humans, astaxanthin supplementation has been studied in a variety of clinical settings and has been proven to have different pharmacological effects. [3, 4]. The beneficial effects of astaxanthin are often associated with its antioxidative [6, 7], anti-inflammatory [8,9], and antiapoptotic properties [10].

Manganese (Mn) is an essential element involved in a number of physiological processes in mammals. It plays a role in endocrine function, immune function, hematopoiesis, and oxidative stress regulation [11]. Manganese may have an impact on thyroid hormone homeostasis and neurodevelopmental processes as a result of both direct dysregulation at the level of the thyroid gland and thyroid hormones, or indirectly via modification of dopaminergic control of the thyroid gland and thyroid hormones [12]. Mn does not directly modulate TSH secretion via the dopaminergic pathway. High levels of Mn are known to reduce thyroid hormones and elevate TSH concentration. However, the results should be interpreted with caution [13].

MATERIALS AND METHODS

Animals thirty (30) male albino rats were obtained from animal house of college of Veterinary Medicine / University of Qadisiyah , weighing from (170-200)g and aged (12-15) weeks. The study started from June 2021 to December 2021.

Preperation of Manganese chloride Mncl2: MnCl2 solution was prepared by dissolving it in sterile water .

Preperation of Astaxanthin: The Astaxanthin was obtained by (DHL EXPRESS. Germany). The dose 50 mg/kg of body weight of male rats for G3 and of Mncl2 and 50 mg/kg of body weight of astaxanthin it was administrated orally for 30 day

RESULTS

Catalase, Malondialdehyde, SOD and GSH Level

these enzymes represented by a significant decrease in the levels of (CAT, SOD, GSH) in G2(treated with Mncl2 only), while a significant increase in the amount of MDA was observed.and significant increase in the levels of (CAT, SOD, GSH) in G3(treated with Mncl2 +Astaxanthin), with a significant decrease in the amount of MDA was observed. as in Table 1 below.

Table 1. Effect of Astaxanthin on enzymetic antioxidant and MDA against toxicity related to manganese chloride in male albino rats.

Groups	GSH (µmol/mg)	CAT (U/mL)	SOD (U/ml)	MDA (µmol/L)
G1	2.55 ±0.06C	1.05±0.05 C	8.26±0.05 C	1.21±0.08 C
G2	1.36±0.14 A	0.37±0.15 A	5.98±0.41 A	3.34±0.10 A
G3	2.18±0.06 D	0.94±0.11 D	7.36 ±0.22D	1.44±0.12 D

*Value represent the mean ± the standard error
* Different letters in one column indicate significant differences (P <0.05) between the totals

Thyroid hormone analysis

The results showed a decrease in the level of T3 and T4 hormones (P<0.05) in the group exposed to Mncl2. Where is in the group of manganese chloride + astaxanthin at a dose of 50 mg | kg body weight for both, The level of T3, T4, and TSH hormones showed a significant difference from the Mncl2 group, where T3, T4 hormones increased and TSH decreased. as in Table 2 below.

Table 2. Effect of Astaxanthin on Thyroid hormones and TSH against toxicity related to manganese chloride in male albino rats.

Groups	T3 mg/dl	T4 mg/dl	TSH IU
G1	1.34±0.059 C	3.67±0.066 C	0.754±0.059C
G2	0.39±0.051A	1.19±0109A	1.42±0.080A
G3	1.19 ±0.10D	3.49±0.078D	0.932±0.057D

*Value represent the mean ± the standard error
* Different letters in one column indicate significant differences (P <0.05) between the totals

DISCUSSION

These enzymes represented by a significant decrease in the levels of (CAT, SOD, GSH) indicating a weak efficacy of endogenous antioxidant factors, while a significant increase in the amount of MDA was observed. Which oxidizes lipid peroxide. Studies have indicated that the main cause of many diseases is an imbalance in antioxidants due to the increase in MDA production after taking Mncl2 (14).

Growing evidence suggests that astaxanthin can reduce oxidative stress and maintain mitochondrial integrity. Many studies proved that astaxanthin sustains mitochondrial function by protecting the mitochondrial redox balance and Astaxanthin significantly reduces physiologically occurring oxidative stress and maintains the mitochondria in a more reduced state, even after stimulation with H2O2. It also Administration of astaxanthin enhances gene expression of antioxidants in peripheral tissues(15) this study agreed with previous studied staxanthin supplementation (5 and 20 mg/d) dramatically reduced the level of biomarkers related to oxidative stress, including malondialdehyde (MDA), and increased SOD and total antioxidant capacity (TAC). These findings indicate the strong antioxidant capacity of astaxanthin(16).

Many questions still remain concerning the relationship between manganese and thyroid hormones. Although not conclusive, experimental findings point to the ability of manganese to interfere with deiodinase activity thus affecting circulating thyroid hormone concentrations [17]. The role of manganese uptake by the thyroid gland is still unclear and the potential mechanisms by which it may directly affect thyroid hormone homeostasis or function remain to be elucidated; however, dose-dependent goitrogenic effects of manganese have been illustrated. It is also noteworthy, that effects of manganese on optimal brain dopamine concentrations, which in turn, affect thyroid hormone homeostasis, may alter the regulatory function of thyroid hormone, both in developing and mature animals [18]. Astaxanthin is a high antioxidant value and supporting the internal antioxidant defence systems, staxanthin reduces oxidative stress and scavenge free radicals due to its chemical structure, its polar groups overlap the polar regions of the cell membrane, while the central non-polar region of the molecule fits into the inner non-polar region of the membrane [19].

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