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EFFECT OF SELENIUM CITRATE ON THE GLUTATHIONE STATUS AND THYROID HORMONES IN RATS WITH EXPERIMENTALLY INDUCED HYPOTHYROIDISM

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Aim. The research aimed to determine the effects of selenium citrate on the characteristics of the antioxidant system and hormone levels in the blood of rats with experimentally induced hypothyroidism.

Materials and Methods. The hypothyroid state was induced using Mercazolil in a dose of 5 mg/kg. The levels of triiodothyronine, thyroxine, and thyroid-stimulating hormone determine a hypothyroid state. Animals under the research consumed selenium citrate at doses of 100 and 200 µg/kg of body weight.

Results. It was found that the levels of thyroid hormones significantly decreased during hypothyroidism and had a tendency to normalize under the influence of selenium citrate. Thyroid-stimulating hormone significantly increased during hypothyroidism, though selenium compounds did not affect its level. Changes in the activity of the glutathione status enzymes were monitored; in particular, glutathione reductase significantly increased, and glutathione peroxidase decreased in animals with hypothyroidism compared to controls. Selenium citrate in amounts of 100 and 200 µg/kg of body weight reduced glutathione reductase activity considerably and increased glutathione peroxidase activity compared to animals with hypothyroidism.

Conclusions. The obtained results indicate a normalization of hormone levels and glutathione link indicators under the influence of selenium citrate in the blood of rats with experimentally induced hypothyroidism. These results form the basis for the development of methods and means for the prevention and treatment of hypothyroidism.

Keywords: selenium citrate, glutathione status, hypothyroidism.

Selenium (Se) is a vital element that prevents oxidative stress. However, its concentration is critical: while Se is an indispensable nutrient, excessive amounts can be harmful. The thyroid gland contains the highest concentration of Se in selenoproteins and is involved in hormone metabolism. A dysfunctional gland can be a sign of hormone deficiency, which can lead to a pathological condition called hypothyroidism [1]. Se supplements can reduce levels of antibodies such as thyroid peroxidase antibody, which often leads to hypothyroidism.

Aim. The study aimed to assess the effects of selenium citrate on antioxidant system parameters and hormone levels in rats with experimentally induced hypothyroidism, and to explore potential corrective strategies for metabolic disorders associated with thyroid dysfunction.

Methods. The study involved 32 male white laboratory rats (290–300 g), fed a standard laboratory diet ("Vita"). Rats were divided into 4 groups: I — control group; II — rats with experimental

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hypothyroidism (EHT); III – rats with EHT treated with selenium citrate (100 μg/kg body weight) in drinking water for one month; IV – rats with EHT treated with selenium citrate (200 μg/kg body weight) in drinking water for one month. Selenium citrate was obtained via aquananotechnology (Nanomaterials and Nanotechnologies, Ukraine). EHT was induced in the rats from groups II, III, and IV by adding 5 mg/kg of Mercazolil ("Zdorovya") daily for 21 days. Hypothyroid state was evaluated by measuring serum triiodothyronine (T3), thyroxine (T4), and thyroid-stimulating hormone (TSH). Glutathione status was determined by the activity of glutathione peroxidase (GPx) and glutathione reductase (GR). Statistical analysis was performed using ANOVA in Microsoft EXCEL.

Results and Discussion. Thyroid hormones exhibit antioxidant properties [2]. In hypothyroidism, key changes include decreased T3 and T4 and elevated TSH, reflecting reduced free radical formation. In group II (EHT), T3 and T4 levels decreased significantly (by 1.5 and 1.3 times, respectively), while TSH increased 10-fold compared to control, indicating a compensatory response from the hypothalamic-pituitary system. TSH levels tended to increase under the influence of selenium citrate compared to the indicators in animals of group II. The effect of Se on TSH levels is controversial. There is published data on the insignificant impact of Se on TSH levels, and there is also data on a decrease in TSH levels [3, 4]. Notably, T3 and T4 levels increased in Se-treated groups, approaching control values (Table). Thyroid hormones regulate the synthesis and degradation of proteins, vitamins, and antioxidant enzymes, and play an essential role in the production of free radicals. Thyroid hormones regulate protein, vitamin, and antioxidant enzyme metabolism and modulate cellular oxidative stress by stimulating various enzyme systems [5, 6].

GR, crucial for synthesizing reduced glutathione, showed a 2.4-fold increase in group II, indicating enhanced synthesis in hypothyroidism. Selenium citrate administration reduced GR activity significantly: by 3 times at 100 μg/kg and 5.9 times at 200 μg/kg compared to the indicators of group II.

GPx, a selenium-dependent enzyme that protects thyroid cells from oxidative damage, was significantly suppressed (by 4.9 times) in hypothyroid rats compared to controls. GPx activity decreased in the blood of animals of groups III and IV by 1.9 and 1.5 under the influence of selenium compared to group I. However, the enzyme was significantly increased by 2.5 and 3.2 times compared to the indicators of group II.

Table. **Effect of selenium citrate on hypothyroidism indicators**

Parameter	Control (n=8)	EHT (n=8)	EHT + Se 100 μg/kg (n=8)	EHT + Se 200 μg/kg (n=8)
TSH (mIU/L)	0.01±0.01	0.13±0.10*	0.14±0.11*	0.16±0.09*
T3 (nmol/L)	1.29±0.49	0.84±0.29*	1.61±0.25	0.89±0.16*
T4 (nmol/L)	18.89±1.86	15.04±1.25*	15.02±0.70*	15.37±0.30*
GR (μmol/ min×mg of protein)	9.69±1.07	23.25±3.21*	7.67±1.17*#	3.94±1.40*#
GPx (μmol/ min×mg of protein)	24.81±0.85	5.11±0.59*	13.01±2.67*#	16.24±5.16*#

Values are means ± SD. EHT: Experimental hypothyroidism; TSH: Thyroid-stimulating hormone; T3: Triiodothyronine; T4: Thyroxine; GPx: Glutathione peroxidase; GR: Glutathione reductase;
*$P < 0.01$ compared to control; #$P < 0.01$ compared to EHT.

Conclusions. Selenium citrate administration helped normalize hormone levels and glutathione system parameters in rats with experimental hypothyroidism. These findings suggest selenium citrate may be valuable for developing strategies to prevent and treat hypothyroidism.

Author contribution

O.O. Sushko carried out: determination of biochemical indicators, calculation of average values and standard errors, statistical analysis of data. R.Ya. Iskra carried out: interpretation and description of data, search and study of literature by topic.

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