EFFECT OF IODINE INTAKE FROM FORTIFIED FATTY PRODUCTS ON IODINE CONTENT OF RATS THYROID GLAND

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INTRODUCTION

Iodine plays an important role in regulating the activity of the thyroid gland [1, 2]. Iodine is an integral part of the two thyroid hormones (thyroxine-T_4 and triiodothyronine-T_3), comprising 65 and 59 percent of their respective weights:

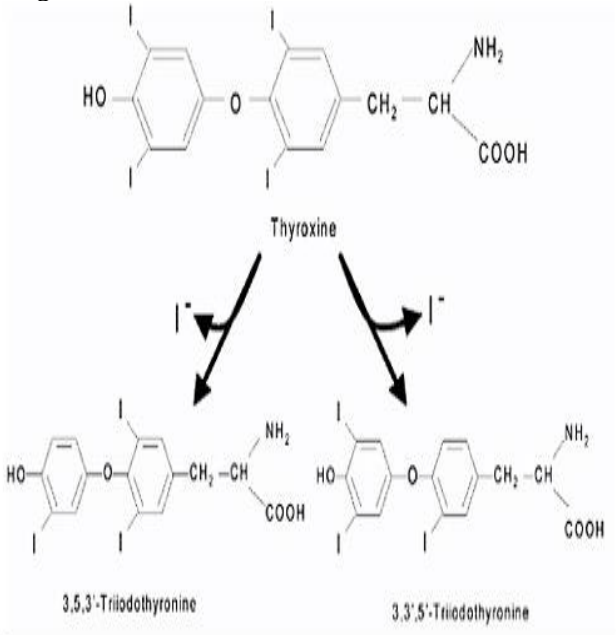

Figure 1. Chemical structure of thyroid hormones [3].

The problem of iodine deficiency (ID) is one of the main problems of the world society [4]. ID affects all population at all stages of life, from the intrauterine stage to old age [5].

Researches performed by WHO and UNICEF in the Republic of Moldova have demonstrated a 37% prevalence of endemic goiter among children and teenagers [6, 7].

The most appropriate way of fighting the iodine deficiency is to produce foodstuff for functional purposes which contain stable forms of iodine [8].

Government Decision nr. 585 "*Decision regarding the approving of national system of eradication of disorders caused by iodine deficit till the 2010*" was approved on 1 June 2007 as a way of addressing the problem of iodine deficiency disorders and was adopted as Law. It provides instructions for the fortification of foodstuffs with nutrients that have insufficient values in local region [9].

In our earlier studies the method and capacity of incorporation of the molecular iodine in the sunflower oil of aboriginal production was investigated [10]. It was established that in the case of the iodination of the oil the addition of the iodine does not take place according to the bimolecular nucleophyle substitution mechanism, but the molecular iodine is fixed to the double bond with the formation of the type π compounds, without breaking the double bond from the unsaturated fatty acids [11]. This allows the incorporation of a considerable amount of iodine (1 - 100 $\mu g / ml$**)** without modifying essentially the physical-chemical properties of the product.

Through physical-chemical methods (UV-VIS, refractometry) the absence of the essential changes in the composition of the fatty acids was established in the samples from the iodinated and non iodinated oils without thermal treatment as well as for those submitted to thermal treatment [12].

It was established that main quality parameters of the iodinated oils (1 - 100 $\mu g / ml$**)** do not vary essentially during thermal treatment and during storage in comparison with the reference sample. In the samples with the highest iodine concentration (1000 $\mu g / ml$**),** where the presence of the free iodine could be noticed, the quality indices surpass the allowed limit value [13]. The accumulation process of the oxidation products has been investigated (amount of the unsaturated aldehydes 2,4-dienale and 2-alchenale) from the iodinated and non iodinated sunflower oil in comparison with the reference sample and as a function of the iodine concentration as well as technological factors of oil treatment (temperature-110, 140 and 170 °C and applied thermal treatment duration – 5-30 min.) [14].

The aim of the research consisted of examination of metabolic displacement in the organism of animals and correction of experimental and spontaneous thyroid pathology by means of

iodinated fatty food products (sunflower oil, margarine).

I. MATERIALS AND METHODS

➢ *Sun flower oil fortification with iodine*

In this study,doubly refined and deodorized oil was used (purchased from local stores) [STAS – 1129-93] [10].

To obtain the iodinated sunflower oil, chemicaly pure, crystalline iodine (I_2) [STAS – 4159- 79] was added [11]. After the establishement of the equilibrium, iodinated oil was used as sample for the present study.

➢ *Manufacturing of iodinated margarine*

In proposed iodinated margarine, a part of sun-flower oil was replaced by iodinated doubly refined and deodorized sun-flower oil with an iodine content of 10μg I/cm^3.

➢ *Investigations in vivo*

For the purpose of elucidation of the influence of food regimes with different content of iodine on bioavailability of iodine from fortified lipidic products and the dynamics of evolution of experimental hypothyroidism, two series of experiments were performed.

The experiment was realized with the lot of white rats of the Wistar line with masses in the range 180 – 210 g. The feed was a standard ration with free access to water. Duration of the experiment was of 42 days. The animals were kept in individual cages, 5 animals in every cage.

The experiment had 2 stages:

Stage I – experimental reproduction of hypothyroidism with the help of mercazole for blocking of thyroid gland function [12]. Daily (14 days) the rats were given to drink water with mercazole. At the same time they were fed by bread without addition of iodinated salt (produce in the laboratory of Technical University of Moldova), with the purpose to exhaust the reserves of iodine of the organism.

Stage II – feed of animals with experimental hypothyroidism (28 days) by:

- Group II - standard ration, without addition of iodine;
- Group III - with additive of sunflower non-iodinated oil;
- Group IV - with addition of iodinated oil with iodine content 3 μg/rat;
- Group V - with addition of iodinated margarine with iodine content 3 μg/rat;
- Group VI - with addition of iodinated oil with iodine content 30 μg/rat (group VI).

Scheme of experimental work with white laboratory rats is presented as Figure 1.

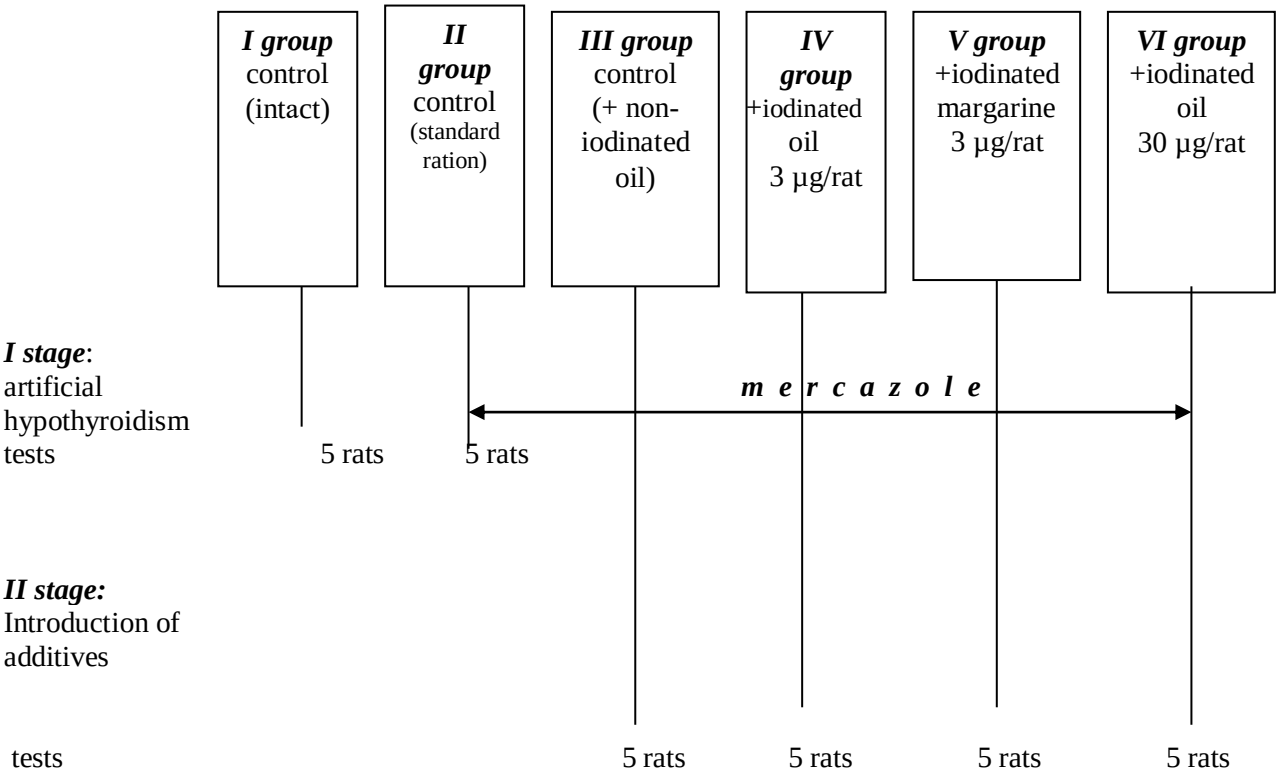

Figure 2. Scheme of experimental work with white laboratory rats.

All the six groups of rats during the experiment received the following foodsuffs: whole-grain wheat porridge prepared on meat broth, so they got the lipid products. The porridge was given daily, for dinner, on the assumption of daily consumption of 12g product/rat.

- *Analysis of iodine content in thyroid glands of investigated rats*

For analysis of iodine content in thyroid glands of investigated rats was used a spectrophotometric method of iodine determination. The Method consists in mineralization of the sample with the following extraction of iodine with carbon tetrachloride in presence of sodium nitrite in acidic medium, measurement of absorption of reaction products on wavelength 514 nm. Relative error of average result consists ±2,05% [13].

- *Determinations of errors and statistical analysis of obtained results*

Investigations realized in triplication and processed statistically by the method of those small squares with application of coefficient Student and determination of interval of investigation [14, 15].

II. RESULTS AND DISCUSSION

The problem of rise of biological availability of iodine from its compound with fats is studies not sufficiently and needs specification.

In the connection there were realized the investigation of study of influence of iodinated fats (sunflower oil and margarine) of different concentration of the capacity of iodine accumulation by thyroid gland of rats.

For getting of the model of artificial hypothyroidism there was used mercazole for blocking of thyroid gland function. Peroxidase catalyzes the oxidation reactions. It is known that the activity of oxidation ferments decreases on hypothyroidism and increases on hyperthyroid states [16].

Mercazole depresses the ferment activity of iodineperoxidase – the ferment which provides the iodination of α – thyroxine, because in the content of thyroxine being the obligatory ingredient is iodine that provokes hypothyroidism [17].

For hypothyroidism confirmation we effectuated the determination of iodine content in thyroid glands of rats (table 1).

Earlier the similar investigations were effectuated by Berenstein F.Ia. [18]. It was established by him that addition to feed of iodine and of potassium iodic positively influence of function of thyroid gland. Iodic preparations assisted not only the improvement of thyroid gland functioning but also made better the use of feed by animals.

Table 1. Effect of iodine intake on iodine content of thyroid gland.

Group of rats	Iodine content of diet, μg/rat	Weight of thyroid gland, mg	Thyroid iodine, mg%
I	0,4 ± 0,1	25,8 ± 1,5	4,8 ± 0,9
II	0,4 ± 0,1	34,2 ± 1,7	1,2 ± 0,7
III	0,6 ± 0,2	18,2 ± 0,9	1,1 ± 0,6
IV	3,5 ± 0,8	24,8 ± 2,2	5,4 ± 0,7
V	3,6 ± 0,7	31,4 ± 3,8	13,0 ± 1,5
VI	30 ± 1,9	39,4 ± 5,7	28,0 ± 1,9

*average daily quantity of feed for rats– 12 ± 4 g

The obtained by us investigations results let us suppose that application of iodinated fats supplies the lack of iodine in animals' organism, and also it has not side effects.

Iodine content in thyroid glands characterizes the intensity and direction of iodine exchange of animals. Realized by us investigations on iodine accumulation in thyroid glands confirmed the positive influence of optimal iodine level (3 μg/rat) on organism of experimental animals. Obtained by us data on

investigation of iodine content in thyroid glands agree with the works of Baranov V.G., Seleatitskaia V.G. [19, 20].

Feeding of experimental animals by optimal iodine level (3 μg/rat) increased the functional activity of thyroid gland and iodine concentration in it. The obtained data agree with the investigation results of Fenchenco N.G., Kashin V.K. [21, 22].

The investigation data indicate that iodinated fats influence on metabolism processes to the accumulation by animals' organism of the iodine, as a result of more effective digestion and assimilability of iodine from present connections.

In whole the investigations of thyroid gland realized by us, proved that is on experimental hypothyroidism the iodine content of rats decreased from 4,8 to 1,2 mg% (groups I and II), so on addition of iodinated fats with iodine content (3 μg/rat) the iodine quantity in thyroid gland increased from 5,4 to 13,0 mg% (groups III and IV). On addition of considerable quantities of iodine (30 μg/rat) the iodine content also increased, but the capacity of thyroid gland to iodine accumulation decreased. (figure 3).

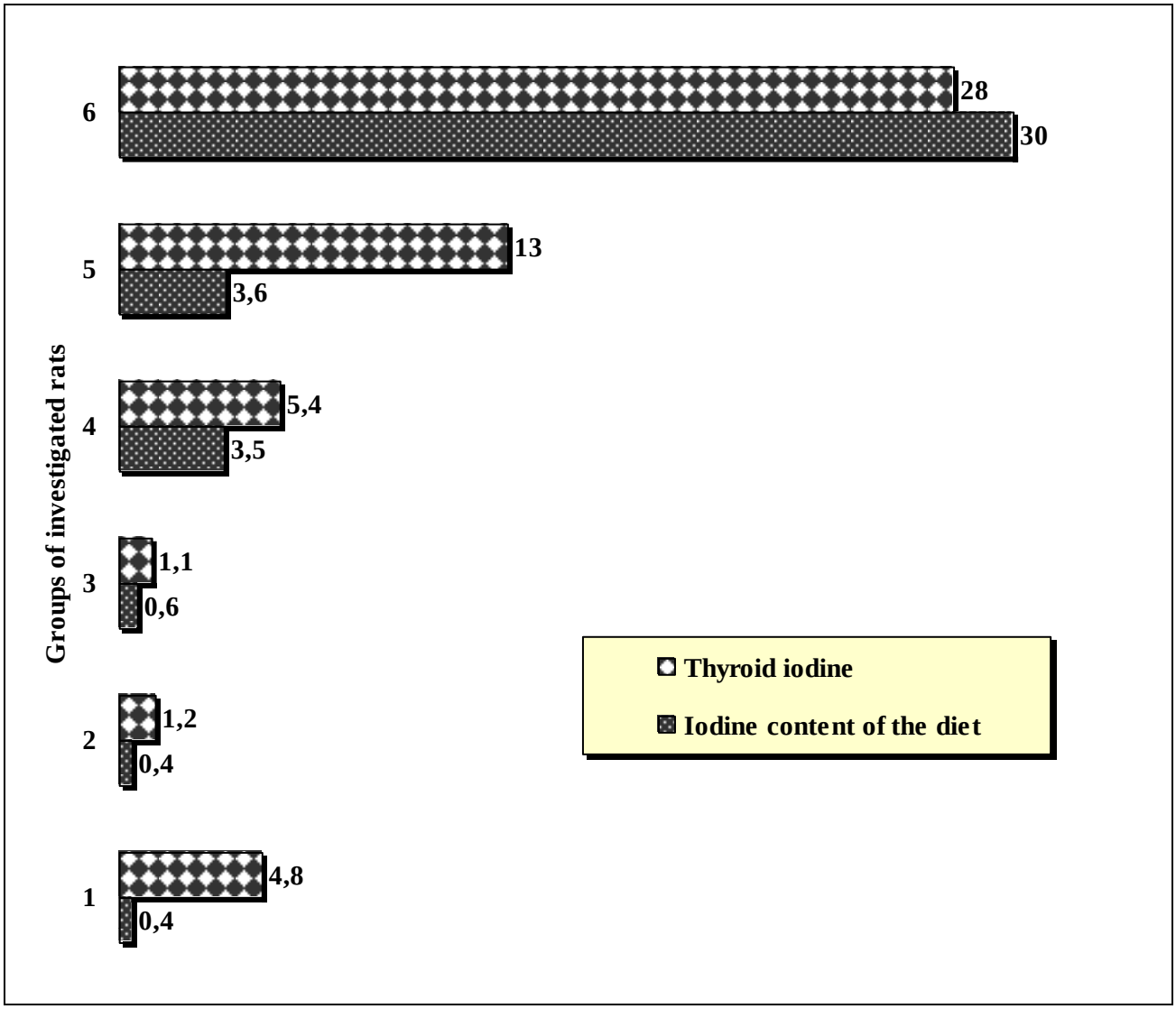

Figure 3. Influence of consumption by animals of iodinated fats on the process of its metabolism .

Analysis of iodine content in thyroid glands, which was obtained from rats after correction of iodine-critical state, at the expense of introduction in their ration of iodinated fats gives the possibility to mention the improvement of functioning and the capacity of iodine accumulation by thyroid gland (figure 4).

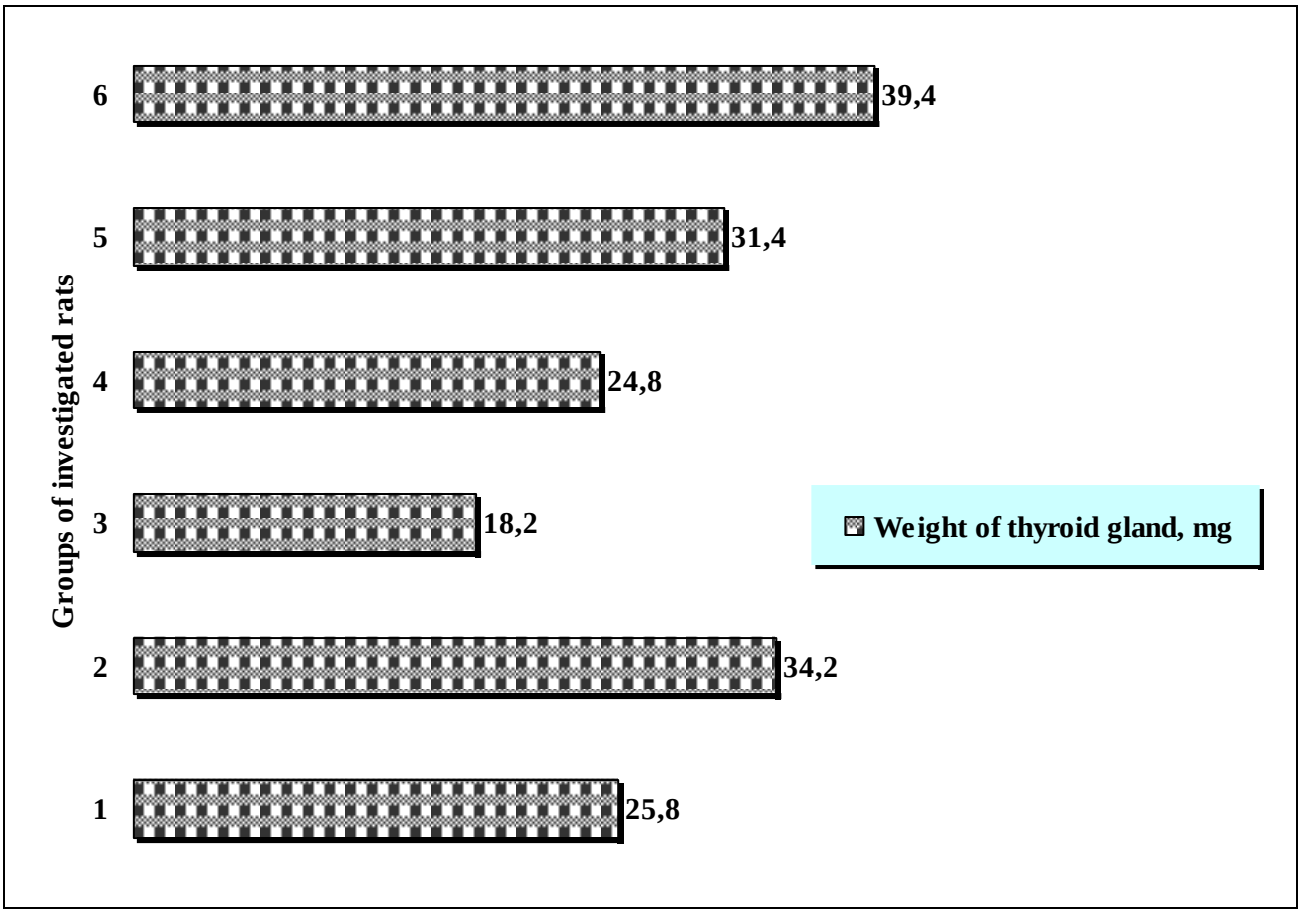

Figure 4. Influence of consumption by animals of iodinated fats on the process of the accumulation capacity by thyroid gland.

Literature data and the results of proper research on laboratory animals lets us conclude concerning the safety, bioavailability and simplicity of use of organically connected iodine forms as iodinated fats (sunflower oil and margarine).

CONCLUSIONS

1. Banding of iodine and vegetable oil gave the fixed organic connection with increased biological value, which is available for obtaining and does not require creation of additional technologies.

2. Investigational data indicate that iodinated fats influence on metabolism processes and contribute to the accumulation of the iodine by animal organism, as a result of more effective digestion and assimilability of iodine from present connections.

3. Application of iodinated fats supplies the lack of iodine in organism, does not have side effects and can be used in prevention of diseases, provoked by iodine deficiency.

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Recomandat spre publicare: 09.10.07