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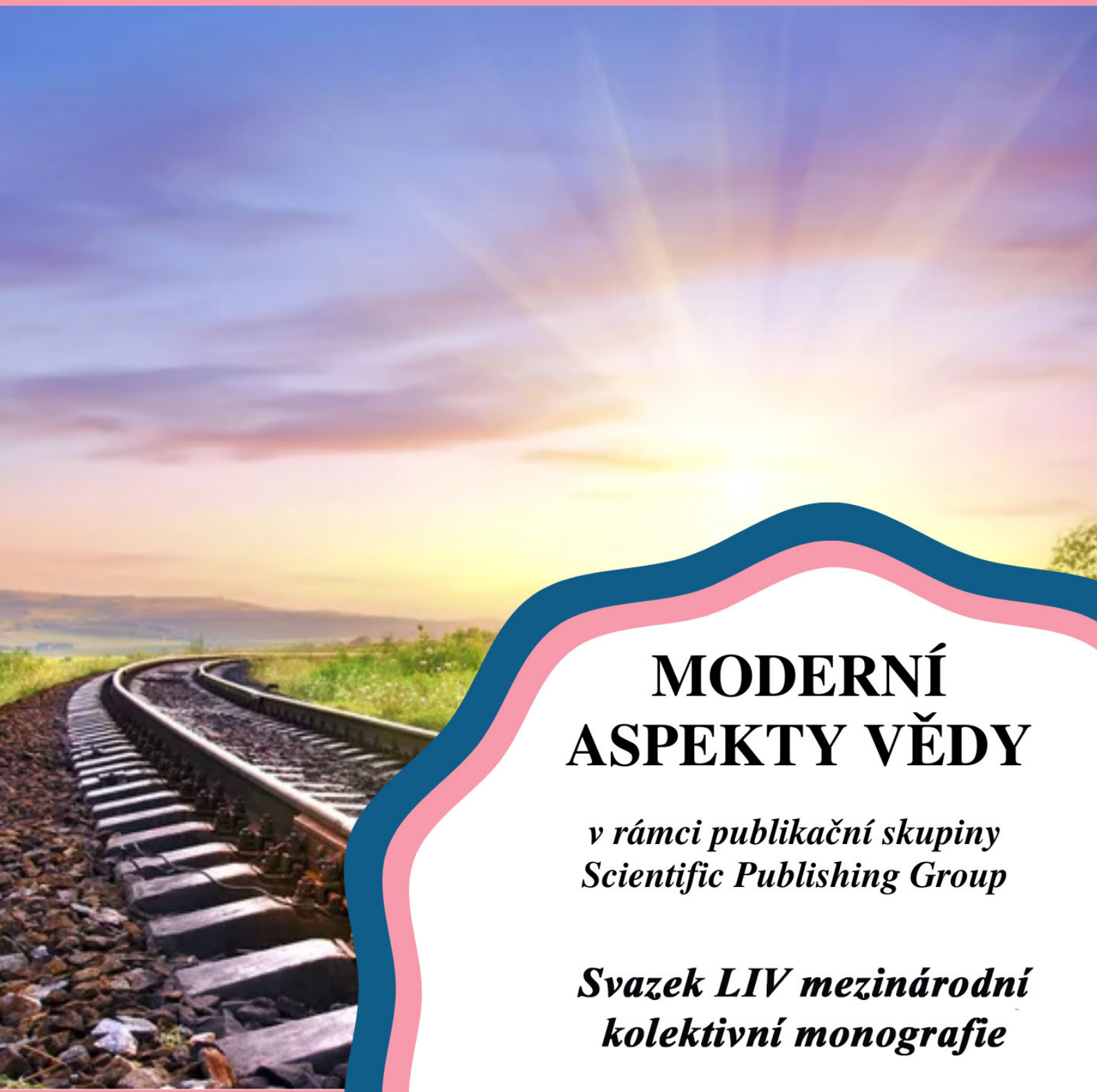

# MODERNÍ ASPEKTY VĚDY

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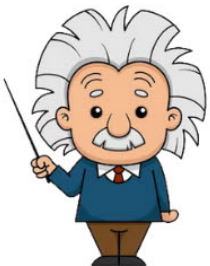
***Svazek LIV mezinárodní kolektivní monografie***



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***Dina Dashevska*** - geolog, geochemik Praha, Česká republika (Jeruzalém, Izrael)

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# ODDÍL 8. VETERINÁRNÍ LÉKAŘSTVÍ

*§8.1 IODINE DEFICIENCY AS A RISK FACTOR FOR ENDOCRINE DISORDERS IN DOMESTIC ANIMALS* (**Ligomina I.P.,** Polissia National University, **Sokulskiy I.M.,** Polissia national university, **Gutyj B.V.,** Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies Lviv, **Soloviova L.N.,** Bila Tserkva National Agrarian University, **Furman S.V.,** Polissia National University, **Lisohurska D.V.,** Polissia National University)

**Introduction.** The animal organism is a complex and dynamic self-regulating system in which the functioning of all systems is closely interconnected and interdependent [1, 2]. The stability of this system is ensured by the stable operation of its functional components [3]. Changes in the physiological parameters of the body, even minor ones, cause significant changes in the biological processes occurring in tissues [4, 5]. This can affect such characteristics as temperature, electrical conductivity, and biogeochemical zones with insufficient or excessive content of mobile forms of trace elements in soils [6, 7, 8]. Such changes indicate how sensitive an organism is to various factors that affect its stability and health.

Dairy farming is one of the leading sectors of the agro-industrial complex, the importance of which is determined not only by its high share in gross output, but also by its significant impact on the agricultural economy and the level of food supply to the population [9, 10, 11]. The state of development of the agro-industrial complex, including its important component - the dairy farming industry, affects the social and economic stability of the economic system. A healthy nation is the key to a successful economy, and high-quality raw materials are the basis for the production of healthy products. Rational use of natural resources, introduction

of innovative technologies in agriculture and compliance with environmental standards contribute to improving product quality, strengthening public health and creating sustainable food security in the country. According to the FAO, 16% of humanity's energy comes from food of animal origin, including milk. At the same time, in Ukraine, consumption of this product is below the medically recommended levels. On average, a Ukrainian consumes less than 200 kg of milk and dairy products per year, while the norm is 380 kg. The situation of the dairy industry is deteriorating every year, and Ukraine, unfortunately, is increasingly relying on imports of dairy products [12, 13, 14].

Milk and dairy products in the food balance are not only basic for the majority of the country's population, but also have a decisive impact on the health of the nation as a whole in terms of the full range of necessary nutrients and consumption volumes [15]. Dairy farming has certain features that distinguish it from other livestock industries: dairy cows are unique in terms of human food production, as they can produce for 5-10 years; milk provides a constant income for business entities throughout the year; milk production is the most stable source of year-round employment [16, 17].

Modern livestock production technologies are based on solving multidimensional and complex issues related to breeding, feeding and keeping animals in premises with optimal microclimate parameters, mechanization of production processes, and efficient labor organization in a particular farm. Digital technologies for monitoring animal health, automated systems for monitoring environmental parameters, and the use of innovative feed additives that increase productivity play an important role in this process [18, 19, 20]. Therefore, the criterion for assessing various production technologies is the compliance of the physiological needs and genetic characteristics of cattle with artificially created environmental conditions, which ensures high productivity, animal health and

rational use of resources. Technology cannot be stable for a long time. It is constantly being improved in line with the development of science, technological progress, zonal characteristics and production requirements. The criterion for evaluating various production technologies is the compliance of physiological needs and genetic characteristics of farm animals with artificial environmental conditions. Important indicators include productivity levels, product quality, animal health, as well as the efficiency of feed and energy use. Maintaining optimal housing conditions, implementing innovative feeding methods and genetic selection helps to increase production profitability, ensure environmental sustainability and improve animal welfare [21, 22, 23].

At the same time, the research of Zubchenko V.V. (2014) shows that in the process of livestock production there is a direct or indirect influence of variability and unpredictability of climatic and biological (evolutionary, genetic, etc.) phenomena and processes, so in the production of dairy cattle, the amount of material resources per unit cannot be a constant value. Reproduction of productive dairy cattle is considered as a cyclical process of life renewal, continuous development of animals in close interaction with the external (natural and technological) environment to restore the main means of biogenic origin in the organization of milk and offspring production [24].

The intensification of modern industrial livestock production involves the development of new technologies, improvement of breeding, use of promising highly productive cow breeds, strengthening of the feed base, timely veterinary measures, which ensures a stable increase in production and improvement of product quality [17, 25]. As is well known, this can be achieved only if metabolic processes in the body of cattle are enhanced. The study of the adaptive potential of the animal body at an early age in order to maintain metabolic homeostasis and ensure normal growth and development remains an urgent problem (26, 27, 28].

For each organism, its own health is extremely important [29]. The main condition for maintaining proper health is the metabolism in the body, and the state of this metabolism is reflected in the analysis of metabolites [30, 31]. First of all, this concerns the circulatory system, endocrine, nervous system, humoral regulation and other systems [32, 33, 34].

Feeding is one of the key factors that affects the growth, development and general physiological condition of animals, as well as determines their metabolic rate [35, 36]. The development of feeding is closely related to the study of metabolism, because the way the animal's body absorbs nutrients affects its productivity and health [37, 38].

Metabolism is a complex of morphological, physical, chemical, and physiological processes responsible for the transformation of nutrients and energy within the body [39]. On the one hand, these are internal processes, and on the other hand, the exchange of these substances and energy between the body and the external environment. This continuous process is the basis for the vital activity of all living organisms, providing them with energy needs and the necessary resources to maintain vital functions. It is through efficient metabolism that the body can maintain homeostasis, adapt to environmental changes, and repair damaged cells and tissues [40].

Minerals are important in physiological processes, the development of pathological conditions, and the formation of an animal's adaptive response [41]. Macro- and microelements are present in a certain ratio in the environment and in the organisms of animals [42, 43]. Their importance can be defined as “synergistic antagonism” of biometals. This means that some trace elements reduce the negative impact on the body, and some may increase it.

To meet its vital needs, humanity is forced to use mineral resources that nature has formed over billions of years [44, 45]. This leads to disruption of natural

cycles and local changes in the dynamic equilibrium of biogeocenoses, which in turn negatively affects biodiversity. All this causes a biological reaction of the local flora and fauna in the biogeochemical zones of Ukraine. In particular, there is a decrease in the number of plant and animal species, which threatens ecosystems and their ability to recover. The biological reactions of animal organisms to geochemical factors can be manifested by endemic diseases, in particular, microelemental diseases [46, 47, 48].

Among non-communicable diseases in humans and animals, iodine deficiency pathology is an important problem worldwide due to its high prevalence and wide range of clinical signs and consequences [49, 50, 51, 52]. The geochemical features of Ukraine's natural regions are also characterized by low iodine content and imbalances of trace elements in environmental objects, high levels of heavy metals and pesticides in soils, and significant emissions of toxic substances into the air, seas, rivers, and soils, which contaminate food. Many regions of Ukraine are classified as disadvantaged in terms of the prevalence of iodine deficiency diseases [53, 54].

Insufficient iodine in the body can lead to the development of endemic goiter, thyroid dysfunction, decreased intellectual abilities, and negatively affect the overall development of the body. Children, pregnant women, and the elderly are particularly vulnerable to iodine deficiency [55, 56, 57].

Several types of thyroid dysfunction are known in dogs: hypothyroidism, hyperthyroidism, adenoma, and cancer. However, the most common type is reduced production of thyroid hormones, which is manifested mainly by hypothyroidism with the development of hypothyroidism and, less often, by increased secretion of thyroid hormones and the associated occurrence of diffuse toxic goiter and thyrotoxicosis syndrome (hyperthyroidism) [58, 59]. In middle-aged dogs, thyroid pathology occurs 2 times more often than in other age groups

and is diagnosed by clinical, pathological, morphological, and biochemical parameters [60].

The main reason for iodine deficiency is the lack of sufficient iodine in food, which is the result of geographical features of the territory, in particular, low iodine content in soils and water in many regions of Ukraine. As a result, a significant proportion of the population is forced to face the consequences of iodine deficiency, which necessitates the implementation of preventive measures [61, 62, 63].

In recent years, a significant number of studies have been conducted on the effect of trace elements on metabolism and harmonics [64]. Mineral elements in the body of animals are structural material, they participate in the processes of digestion and absorption in the digestive tract, synthesis, breakdown and excretion of metabolic products, are part of complexes with proteins, forming specific enzymes, and also serve as components of certain hormones, vitamins, stabilize acid-base balance and osmotic pressure, which regulate metabolism and a number of other very important body functions [65, 66, 67]. The total iodine content in the body of sheep is 0.3 - 0.7 mg per 1 kg of live weight [68]. And as already mentioned, most of it (about 60%) is found in the thyroid gland. To date, iodine has been found to be associated with the body's resistance to disease. The consequence of iodine deficiency is thyroid hyperplasia [69]. With a constant iodine deficiency, animals, as well as humans, develop endemic goiter, which leads to a decrease in the activity of metabolic processes, increased deposition of fat and inhibition of protein synthesis, impaired reproductive capacity, and a decrease in the genetic potential for productivity not only in the individual but also in the offspring [70].

Traditionally, Western Ukrainian regions (Lviv, Ivano-Frankivsk, Zakarpattia, Volyn, Rivne, Ternopil, Chernivtsi) have been considered iodine-deficient in Ukraine, but recently the prevalence of iodine-deficiency diseases has been

revealed in the northern regions (Zhytomyr, Kyiv, Sumy, and Chernihiv) and the central region (Vinnytsia, Poltava, Cherkasy, and Khmelnytsky). The presence of iodine deficiency is observed almost throughout Ukraine [71, 72, 73].

At the same time, the problem of metabolic disorders is one of the most acute in modern livestock production [74]. For optimal realization of the genetic potential of animal productivity, it is essential to prevent and treat diseases caused by deficiency or excess of various minerals in diets, which lead to reduced productivity and even death of animals. The most common of these diseases is endemic goiter, or hypothyroidism, which is caused by iodine deficiency.

Elemental homeostasis is a special form of the general homeostatic system of the body, disorders of which affect the body's ability to adapt to extreme conditions. The full content of essential elements (iodine, cobalt, copper, zinc) is one of the most important components of the body's normal functioning [72]. That is why the important role of trace elements in the vital activity of an animal organism is beyond doubt.

Fundamental research of biogeochemical zones and provinces of Ukraine, study of the specifics of clinical manifestation and course of microelementoses in animals, in particular in cattle, development of methods of their diagnosis, therapy and prevention were performed by well-known Ukrainian scientists M.O. Sudakov and V.I. Levchenko and their students [73, 74].

However, over the past thirty years, Ukraine's biogeochemical zones have experienced significant changes in the mineral composition of soils due to man-made and anthropogenic impacts. This has led to contamination of the territories with heavy metals, radionuclides, etc. The complicating effect of unfavorable anthropogenic environmental factors that cause changes in biogeocenosis in interaction with the natural deficiency of essential (vital) nutrients contributes to the emergence and spread of mineral metabolism pathology in farm animals, in particular, lactating cows.

Hypothyroidism is widespread in many countries, including Ukraine. The situation is considerably more complicated in the Zhytomyr region, where a significant part of soils and water bodies was contaminated by radioactive contamination as a result of the Chornobyl accident [75, 76]. In-depth scientific research on biogeochemical zones and provinces of Ukraine, studying the specifics of clinical manifestations and the course of trace element deficiencies in animals have been conducted by well-known Ukrainian scientists [53, 77].

**Presenting main material.** The research work was carried out within the framework of the State Initiative Theme: “Biochemical and morphological changes in domestic animals with metabolic and invasive pathologies”.

Object of study - clinically healthy and sick cows with milk yield from 3.5 to 6.5 thousand kg of milk per lactation in clinically healthy and sick animals with signs of mineral metabolism disorders, clinical studies were conducted according to the generally accepted scheme with a parallel blood test and analysis of animal housing and feeding. In the course of the work, a comprehensive analysis of the physiological and biochemical mechanisms of animal adaptation to pathological conditions was carried out, the influence of metabolic processes and the structural organization of tissues were studied.

The results obtained allow us to deepen our understanding of disease development and develop effective methods for diagnosing, preventing, and treating metabolic pathologies in domestic productive animals. The study will contribute to the improvement of veterinary and sanitary measures and optimization of approaches to animal health in farms.

The research was conducted in three districts of the Zhytomyr region: Korosten, Narodychi, and Popilnia. The region is located in two natural and climatic zones: its northern part is in the Polissia zone, and its southern part is within the Forest-Steppe zone. The Polissia region of Zhytomyr Oblast, including

Narodnytsia and Korosten districts, belongs to the northeastern biogeochemical zone with low iodine, cobalt, copper, manganese and zinc content in soils and plants. The content of mobile forms of copper in the sandy soils of Polissya does not exceed 1.5 mg/kg of air-dry weight. All soils in the region are poor in zinc, with 45% of soils containing less than 0.05 mg/kg of zinc and are classified as critically poor. The soils of the experimental farms are critically poor in zinc. In the northern part of the Korosten district, the amount of cobalt in the soil is 1.13 mg/kg, while the soils of the Narodychi district contain 1.6 mg/kg of cobalt and 3.3 and 3.7 mg/kg of iodine, respectively. The iodine content in water is 1.0-5.38 µg/l, which is significantly less than the optimal amount (16-20 µg/l).

The biogeochemical features of the Zhytomyr region have been significantly complicated by the application of large amounts of lime to the soil: 8-10 tons per hectare of calcium carbonate. It is known that calcium is an antagonist of mobile forms of yttrium, copper and zinc, which negatively affects their absorption by plants. In addition, the presence of radioactive strontium and cesium in soils and feed also negatively affects the processes of migration and transformation of these elements.

Since the content of mobile forms of trace elements in the soils of Zhytomyr region is low, this contributes to a decrease in their amount in feed. For example, cobalt, copper and iodine are low in grass silage, grass hay, concentrated feeds, red clover green mass, grass of floodplain dukes, iodine and copper in barley straw.

A clinical study of dairy cows was conducted in the districts of Zhytomyr region. Blood samples were taken from 90 cows (59, 16 and 15 heads, respectively).

The functional state of the thyroid gland was studied by the thyroxine content, which was determined by ELISA using the Triniti Biotech Cahtia T4 test system. The hemoglobin content was determined by the hemoglobin cyanide

method, and the total red blood cell count by the melange method. On the basis of these data, the hemoglobin content per erythrocyte (HCE) was calculated. The acid resistance of erythrocytes with the subsequent construction of erythrograms was studied according to I.I. Gitelzon and I.A. Terskov in the modification of V.P. Moskalenko [81].

It is worth noting that the research (manipulations) on animals were carried out in accordance with the existing regulatory documents governing the organization of work using experimental animals and compliance with the principles of the European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes (Strasbourg, 1986) [82]. The General Theoretical Principles for Experiments on Animals, approved by the First National Congress on Bioethics (Kyiv, 2001) [82, 83].

Statistical processing of the obtained digital data was performed using Microsoft Excel. The mean arithmetic values (M), mean square error (m), and correlation coefficient (r) were determined. The significance of differences was assessed using Student's t-test [84]. The results of the obtained digital data of the studied indicators were considered significant at $p<0.05$-$0.001$.

The terrain of Ukraine is characterized by a mosaic combination of biogeochemical areas with a reduced iodine content in environmental objects and areas with anthropogenic and man-made environmental pollution with heavy metal ions, substances with thyroid disrupting and radioactive properties. All these factors have the ability to affect various links of the hypothalamic-pituitary-thyroid axis, which can disrupt the synthesis, secretion, and transport of thyroid hormones, distort their local effect on target cells, and cause functional and organic changes in the gland with subsequent disorders of the whole organism [65, 84].

Monitoring of the scientific literature suggests that animals can adapt to the deficiency of certain minerals. However, if the minerals in the feed do not meet the

minimum needs of the organism and the diet does not meet the biological characteristics of the animals, then the animals may lose the ability to normal development, metabolism is disturbed, and their reproductive capacity decreases [54, 85].

Iodine is one of the main minerals necessary for the normal functioning of an animal [86]. Iodine is the only trace element - an anion - that determines its ability to affect metabolic processes, vital activity, differentiation of cells and tissues of the animal body [87, 88]. The main functions of iodine in the body are associated with participation in the regulation of the rate of biochemical reactions, energy metabolism, body temperature, induction of increased oxygen consumption by tissues, as well as participation in the regulation of protein, fat, carbohydrate and water-electrolyte metabolism, regulation of tissue differentiation, growth and development processes, including neuropsychological processes. In addition, iodine is involved in the regulation of certain vitamins metabolism. Iodine deficiency occurs when iodine intake falls below recommended levels. It is an environmental phenomenon that occurs in many parts of the world [89, 90].

According to scientists [47, 48, 91, 92], iodine deficiency syndrome is manifested mainly by hypothyroidism (hypothyroidism, goiter). It is characterized by insufficient secretion of thyroid hormones by the thyroid gland or cessation of its function [93, 94, 95, 96].

In the northeastern biogeochemical region of Ukraine, the disease of animals with iodine deficiency (hypothyroidism) attracts special attention of scientists. The natural lack of iodine and other biogenic trace elements (cobalt, copper and zinc) changes the functional activity of the thyroid gland, causes its morphological restructuring and leads to disruption of functional and metabolic processes in the animal body.

The thyroid gland is one of the most important endocrine glands, the physiological activity of which is essential for the normal functioning of the human

and animal body. In many respects, the thyroid gland is a unique specific endocrine organ that concentrates iodine and synthesizes thyroid hormones, triiodothyronine and thyroxine, which play a significant role in regulating metabolism and energy in humans and animals, as well as in ensuring behavioral adaptive responses. Lack of iodine, especially in the biogeocenoses of the northeastern region of Ukraine, is a stable natural factor and generally negatively affects the functional activity of the thyroid gland and contributes to the development of pathological processes in it. Thyroid pathology attracts the attention of biologists, veterinary and humane medicine specialists due to the complexity and insufficiently studied pathogenesis, versatility and significant dysfunctions of many organs and body systems. In iodine deficiency, the main pathomorphological changes are localized in the thyroid gland.

External examination of the animals revealed swelling in the interjaw space - myxedema, which was found in only 5 out of 90 dairy cows (5.6%), mostly from Narodytsky district (8.9%), compared to 2.2% in Korosten district. Myxedema is a typical manifestation of iodine deficiency [48].

A typical sign of iodine deficiency is an increase in the size of the thyroid gland. A slight increase in its size cannot be detected by examination or palpation, as thick and rough skin makes such examination difficult. Therefore, goiter was diagnosed only in 3 cows out of 90 (3.35%), all of them were in Narodytsky district (6.7%). The increase was bilateral, the consistency of the gland was dense. Similar symptoms were described in the literature by prominent scientists who made a decisive contribution to the study of trace element deficiencies [91, 95, 97].

Enophthalmos was detected in 24 dairy cows out of 90 (26.7%), including 16 out of 45 cows (35.4%) in Narodytskyi district, and this symptom was not detected in dairy cows of Popilnyanskyi district.

During the study of the cardiovascular system, bradycardia and a tendency to its development were detected in 52 out of 90 cows (57.8%). Bradycardia is

caused by a relative increase in the tone of the vagus nerve (due to a decrease in the tone of the sympathetic nerve in hypothyroidism), as well as a decrease in myocardial sensitivity to catecholamines [25]. In addition to bradycardia, cows showed splitting of the first or second tone and weakening of the first or both tones, sinus arrhythmia. As for other symptoms, typical signs of micronutrient deficiency were found in the area of biogeochemical province and radioactive contamination: dryness and reduced skin elasticity, alopecia in different parts of the neck and lower back, growth of long coarse hair on the head between the horns and on the withers, dull, tousled hair. Such changes were observed in 80% of dairy cows from farms in Narodytskyi and Korosten districts and only in one third of cows in Popilnia district. Changes in the hair coat are characteristic of polymicroelement (iodine, cobalt, copper) deficiency.

Anemia of the conjunctiva was found in 84.4% of cows in Korosten and 95.5% in Narodychi districts: its color was from pale pink to pale and even with a porcelain tint.

The number of erythrocytes in cows from the territory of radioactive contamination was 4.6±0.15 ($p<0.001$) and 4.7±0.14 ($p<0.001$) T/l, respectively, compared to 6.4±0.17 T/l in cows of the control group. Oligocythemia was found in 75 % of cows in Korosten and 80 % in Narodytsky districts.

The average hemoglobin content in cows of Narodytsky district was 94.8±2.3 ($p<0.001$), and Korosten district - 98.7±3.0 g/l ($p<0.001$), compared to 113.3±1.8 – in Popilnyansky, among dairy cows this indicator was reduced in - 41.7% of cows from both zones. For a more detailed analysis of the nature of these changes, we calculated the hemoglobin content per erythrocyte (HCE).

The study of HbE showed the development of hyperchromia in 62.5% of cows in Korosten and 60% in Narodychi districts. The remaining cows had normochromic red blood cells.

Anemia is a decrease in the number of hemoglobin or red blood cells per unit volume of blood, or both indicators in parallel. The analysis shows that anemia was detected in 17 cows out of 20 (85%) in the Narodytsky district, with 64.7% of cows having hyperchromic anemia and 35.3% having normochromic anemia. In 9 cows out of 17 (52.9%), both oligocythemia and oligochromemia were observed. Anemia in 66.7 % of them was hyperchromic, and in the rest - normochromic.

Hematopoiesis in diseased cows is characterized by severe oligochromemia and hyperchromia, and they simultaneously showed changes characteristic of endemic goiter and hyperchromic anemia.

Also interesting, from the point of view of bone marrow function, was the study of red blood cell age. According to the data obtained, it can be seen that in cows from Narodytsky district, the proportion of “young” red blood cells ranges from 42.5% to 53.2% and averages 48.5 ± 1.2%, and the proportion of old ones is significantly ($p<0.05$) higher compared to cows from other districts (14.8 ± 0.94%).

Acid hemolysis of erythrocytes in cows in the zone of polymicroelement deficiency and low-intensity radiation was characterized by longer cell destruction, lower and shifted to the right main peak, compared to erythrocytes in cows from the clean zone, which were kept on a balanced diet. The release of the main peak of the experimental cows began at the 4th minute, which is 0.5 minutes later, and its height was 10.8% lower than in the control group (17.2% vs. 28.0%). The erythrocytes of the experimental cows underwent maximum hemolysis at 5.5 minutes, while those of the control cows - at 4.5 minutes. Complete destruction of red blood cells was observed at 9 and 7 minutes, respectively. Thus, the acid resistance curve (erythrogram) is characterized by a longer left part, which is an indicator of a larger number of “old” red blood cells in the blood, and an extended

(longer) right part, which characterizes an increased number of “young” red blood cells that are more resistant to hemolysis.

Soils and water sources of the northeastern biogeochemical zone of Ukraine are characterized by a natural lack of biogenic iodine and its synergists: cobalt, copper and zinc [47], which primarily causes morphological changes in the thyroid gland and changes in its functional activity in humans and animals. It should be noted that even when feeding animals with a balanced diet of biogenic microelements, the level of their biological activity is largely determined by the ecological state of the environment [98, 99, 100].

At the same time, an important factor in the development of goiter is iodine deficiency in soils and groundwater. According to this indicator, the northern districts of Zhytomyr region are among the regions where the probability of a goiter endemic is medium and sometimes high. Thus, the development of this pathology is complicated by the low content of synergists (Cobalt, Copper, Zinc) and the increased content of iodine antagonists – $^{137}Cs$, $^{90}Sr$, Lead. The imbalance of mobile forms of trace elements in soils is one of the important factors in the emergence and development of endemic thyroid hypofunction in animals.

Most of the symptoms of pathology in cows described by us are typical of hypothyroidism. It is important to establish functional changes in thyroid pathology, which are determined by the level of triiodothyronine ($T_3$) and thyroxine ($T_4$). A significant number of patients have a tendency to develop thyroid hypothyroidism.

To confirm this diagnosis, we determined the amount of $T_4$ (thyroxine) in the blood serum of 10 cows from the Narodytsky district and 6 cows from the Korosten district (Table 1).

*Table 1.*

**Thyroxine content in the blood serum of cows from experimental and control farms**

| District. | Biometric indicator | $T_4$ | |
|---|---|---|---|
| | | mcg/100 ml | nmol/l |
| Korostensky | Lim<br>M ± m | 4,1 – 8,0<br>5,3 ± 0,65 | 52,8 – 103,0<br>69,0 ± 8,4 |
| Naroditsky | Lim<br>M ± m<br>t=<br>p< | 2,2 – 4,25<br>3,4 ± 0,21<br>2,86<br>0,05 | 28,3 – 54,7<br>43,8 ± 2,7<br>2,86<br>0,05 |

It was found that the thyroxine content in dairy cows ranged from 2.2 to 4.25 μg/100 ml (28.3-54.7 nmol/l) and averaged 3.4±0.21 μg/100 ml (43.8±2.70 nmol/l, in cows from Popelnyansky district (conditionally clean area) - 5.3±0.65 nmol/l.

While in cows from the Popilnyansky district the $T_4$ content was more than 4 μg/100 ml (>51.6 nmol/L), in cows from the Narodytsky district only one cow (10%) had thyroxine more than this amount, and there were 9 cows with thyroxine less than 50 nmol/L (90%). Thus, the cows of the experimental farm were found to have hypothyroidism.

**Conclusions.** The combined effect of environmental factors such as a deficiency of iodine synergists and an excess of antagonists causes the development of iodine deficiency in animals, which is accompanied by a decrease in the functional state of the thyroid gland and the development of hypothyroidism. Clinical studies in cows have revealed symptoms typical of iodine deficiency: dryness and hyperkeratosis of the skin, enophthalmos, anemia of the conjunctiva, bradycardia, thyroid enlargement and myxedema. The deficiency of iodine synergists (cobalt, copper) causes hematopoiesis disorders and anemia in 85% of cows, which is expressed by oligocythemia and oligochromemia.

Anemia is mainly macrocytic and hyperchromic, less often normochromic. Hypothyroidism was detected in 90 % of cows: the thyroxine content ranged from 28.3 to 54.7 nmol/L and averaged 43.8 ± 2.7 nmol/L (3.4 ± 0.21 μg/100 ml). The results obtained indicate the need to develop and implement measures to correct the iodine balance in the body of animals, including dietary enrichment with appropriate trace elements, monitoring of thyroid hormone levels and development of programs for the prevention of iodine deficiency in cattle.

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