

## PREVALENCE AND STRUCTURE OF METABOLIC DISEASES OF LAYING HENS

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### INTRODUCTION

Domestic poultry farming is one of the most economically attractive and competitive types of agribusiness, which is indicated by the steady dynamics of growth in the production of poultry meat and eggs<sup>1</sup>. At the current stage of socio-economic development, in conditions of constant growth in food prices, products of the poultry industry are an essential element of the diet of the majority of the population<sup>2</sup>. Poultry farming is the fastest-growing and most flexible of all livestock industries. This industry, primarily due to robust demand, has expanded, consolidated, and globalized over the past 15 years in countries of all income levels. Ukraine is no exception. As the author points out, Ukraine has great prospects for the development of poultry farming<sup>3</sup>. Yu.V. Kernasyuk analyzing the number of poultry in Ukraine, notes that in the early 2000s, there was only 123.7 million poultry in all categories of farms; in 2015, their number increased to 214.6 million, or almost 1.7 times, in 2021 – 107.8 million poultry heads. In individual peasant farms, the decrease in livestock was less noticeable (-1.7% annually). Today, there is 84.7 million poultry on farms, but since January of this year, the population has decreased by 6.8%. The most significant number of poultry is kept in the Vinnytsia (32.2 million heads), Cherkasy (23.6 million), and Kyiv (23.1 million) regions.

According to the information from the Poultry Breeders' Union of Ukraine, in 2015, the production of eggs in our country amounted to

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<sup>1</sup> Лопатин Л.В. (2012). Стан та перспективи розвитку птахівництва в Україні. *Аграрний вісник Причорномор'я*, 65, 42–46.

<sup>2</sup> Царук Л.Л. (2017). Сучасний стан виробництва продукції птахівництва в Україні. *Сучасні проблеми селекції розведення та гігієни тварин*, 1 (95), 159–170.

<sup>3</sup> Меленюк С. (2021). Птахівництво України та Польщі. *Наше птахівництво*, 1 (73), 14-17.

16.8 billion. In 2020, egg production in Ukraine decreased by 2.9% compared to 2019 – to 16.2 billion pieces, and the share was about 1.5% of all eggs produced worldwide. Currently, Ukraine is one of the world's leading producers of chicken eggs and occupies a decent 11th place in the international ranking. Thus, in 2018, Ukraine exported a record 1.7 billion eggs, 21% more than in 2017, when 1.48 billion eggs were exported. Exports grew by 37% in monetary terms and reached 94.1 million US dollars. And in 2019, according to the State Customs Service, 137.1 thousand tons of eggs were exported, which is 27.5% more than in 2018<sup>4</sup>. According to the State Customs Service, in 2021, Ukraine exported 27.3 thousand tons of eggs. In monetary terms, exporting eggs for seven months brought \$28.4 million. The main buyers of Ukrainian eggs in January-July 2021 were the UAE (37.9%), Latvia (25.5%), and Saudi Arabia (6.9 %).

The modern technology of industrial poultry breeding is associated with a significant functional load on its body. This leads to metabolic disorders and the development of metabolic diseases, which account for up to 90% of internal pathology.

Poultry of modern high-performance crosses and lines are susceptible to the negative impact of technological and stressful factors that lead to certain deviations in metabolism and physiological functions<sup>5</sup>. As the author notes, it is urgent to carry out systematic research to clarify the physiological and biochemical features of the growth and development of poultry, which will make it possible to develop methods of regulating metabolic processes and improve the quality of products (eggs and meat).

According to the authors, metabolic diseases are conventionally divided into four groups: 1) diseases caused by a violation of carbohydrate-lipid and protein metabolism; 2) diseases caused by a

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<sup>4</sup> Копитець Н.Г., Волошин В.М. (2019) Оцінка цінової ситуації на ринку м'яса птиці. *Економіка АПК*. № 11. С. 42-49. doi.org/10.32317/2221-1055.201911042.

<sup>5</sup> Кирилів Б. Я., Ратич І. Б. (2001). Вміст загальних ліпідів і співвідношення їх окремих класів у плазмі крові і тканині печінки курей-несучок за різної кількості ліпідів раціону. *Науково-технічний бюлетень Інституту біології тварин*, 1-2, 21-26.

violation of the metabolism of macroelements; 3) diseases caused by a lack or excess of trace elements; 4) hypovitaminosis.<sup>6 7</sup>

The occurrence of metabolic diseases is associated with the quality and mode of feeding poultry at large industrial complexes<sup>8 9 10 11</sup>. The use of various sorbents, pre- and probiotics, biogenic growth stimulators, and biologically active substances for poultry feeding has become an integral component of compound feed recipes<sup>12 13 14 15</sup>. However, even such measures do not protect the bird from metabolic diseases.

The problem of preserving the metabolic homeostasis of the organism of laying hens for their practical life under the influence of negative anthropogenic factors in the conditions of modern poultry farming, such as unsatisfactory ecological situation, insufficient and

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<sup>6</sup> Внутрішні хвороби тварин [текст]: підручник / В.І. Левченко, І.П. Кондрахін, В.В. Влізло та ін.; за ред. В.І. Левченка. – Біла Церква, 2017. – Ч. 2. – 393–441 с.

<sup>7</sup> Ветеринарна клінічна біохімія [текст]: підручник / В.І. Левченко, В.В. Влізло, І.П. Кондрахін та ін.; за ред. В.І. Левченка і В.Л. Галяса. – Біла Церква, 2019. – 400 с.

<sup>8</sup> Yousefi M., Shivazad M., Sohrabi-Haghdoust I. (2005). Effect of Dietary Factors on Induction of Fatty Liver-Hemorrhagic Syndrome and its Diagnosis Methods with Use of Serum and Liver Parameters in Laying Hens. *Int J Poult Sci.*, 4, 568–572. doi: 10.3923/ijps.2005.568.572

<sup>9</sup> Водолажченко С. (2011). Кормовые факторы вызывают заболевания птицы. *Корми і факти*, 8 (12), 22–23.

<sup>10</sup> Вернер А. (2013). Рациональный подход к использованию кормовых добавок в рационах птицы. *Тваринництво сьогодні*, 8, 41–42.

<sup>11</sup> Новожилова Є. В. (2014). Вимоги ЄС до кормів при імпорті продукції тваринництва. *Ексклюзивні технології*, 1 (28), 51–53.

<sup>12</sup> Leeson S. (1999). Considerations for using enzymes in poultry nutrition. *Intern. Symp. On Poult. Nutr. Proc.* FACTA. Brasil, 73–186.

<sup>13</sup> Машкін Ю. В. (2010). Гематологічні та біохімічні показники крові курчат-бройлерів під впливом пробіотика «Протекто-Актив». *Сучасне птахівництво*, 1-2 (86-87), 26-27.

<sup>14</sup> Stoianovskyy, V., Shevchuk, M., Kolomiets, I., & Kolotnytskyu, V. (2020). Dynamics of individual indicators of protein metabolism in the body of broiler chickens on the background of combined stress when included in the diet “Reasil Humic Vet” + “Laktin” and “Reasil Humic Health”. *Ukrainian Journal of Veterinary and Agricultural Sciences*, 3(2), 42-46. <https://doi.org/10.32718/ujvas3-2.07>

<sup>15</sup> Яремчук В.Ю., Слівінська Л.Г., Стронський Ю.С. (2020). Морфологічні особливості печінки курей-несучок кросу “Ломан Браун” за гепатозу. *Науковий вісник Львівського національного університету ветеринарної медицини та біотехнологій імені С.З. Гжицького*. Серія: Ветеринарні науки, 22 (97), 69–73.

inferior feeding, and violations of housing conditions, remains especially relevant<sup>16 17</sup>.

### 1. Prevalence and structure of metabolic diseases of laying hens

The most common pathologies among laying hens are hepatodystrophy – 70–80%, uric acid diathesis from 40 to 70%; subclinical course of hypovitaminosis A and E (up to 80%), diseases of the musculoskeletal system (30–35%)<sup>18 19</sup>.

In the poultry's body, all types of metabolism are closely interconnected, so any disease causes a violation of homeostasis. Still, the leading cause of the disease is a violation of one or two types of metabolism. Several factors can cause increased fat deposition in liver cells, including high egg production, toxins, nutrient imbalances, excessive consumption of high-energy diets, deficiencies in nutrients that mobilize fat from the liver (lipotropic agents), endocrine imbalances, and genetic components. In laying hens, this disease is the result of excessive fat accumulation when the transport of lipoproteins is disturbed<sup>20</sup>.

In highly productive crosses of laying hens, the central organ of homeostasis is the liver, which works in a particularly intense mode, as it

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<sup>16</sup> Bicudo, J. E. P.W., Buttemer, W. A., Chappell, M. A., Pearson, J. T., & Bech, C. (2010). *Ecological and Environmental Physiology of Birds*. (1st ed.) Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780199228447.001.0001>

<sup>17</sup> Антоненко П. П., Ковальова І. В., Чорний М. В., Гарнаженко Ю. А., Пушкар Т. Д. (2017). Біохімічні показники крові курей-несучок за впливу селеніту натрію та кормових фітопрепаратів. *Аграрна наука та харчові технології*, 3(97), 3-10.

<sup>18</sup> Мельник А. Ю. Клініко-біологічне обґрунтування методів діагностики та профілактики порушень фосфоро-кальцієвого обміну і D-вітамінного обмінів у курей-несучок: автореф. дис. канд. вет. наук / А. Ю. Мельник. – Біла Церква, 2008. – 22 с.

<sup>19</sup> Мельник А.Ю. (2015). Аналіз і перспективи галузі птахівництва України, поширення та класифікація метаболічних хвороб сільськогосподарської птиці. *Науковий вісник ветеринарної медицини*, № 2. – 67-73.

<sup>20</sup> Juliet R. Roberts (2004). Factors Affecting Egg Internal Quality and Egg Shell Quality in Laying Hens. *The Journal of Poultry Science*. – Vol. 41 Is. 3. – P. 161-177. [doi.org/10.2141/jpsa.41.161](https://doi.org/10.2141/jpsa.41.161).

is involved in the exchange of proteins, carbohydrates, lipids, vitamins, macro- and microelements, bile formation and bile secretion<sup>21 22 23 24 25</sup>.

In the structure of internal non-contagious diseases of poultry, liver pathology makes up 5% to 50.8%<sup>26</sup>.

The following are diagnosed: hepatitis, hepatodystrophy, cirrhosis, liver abscesses, cholecystitis, and gallstone disease. A particular interest of scientists is observed in studying lipid metabolism, which is connected with its multifaceted functions in the body's metabolic processes.

In laying hens, in particular, among internal diseases, hepatodystrophy is the most common and is accompanied by a severe course of the disease<sup>27</sup>.

Given this, the improvement of poultry's standards of feeding and maintenance is constantly ongoing based on an in-depth study of carbohydrate, lipid, protein, and mineral metabolism.

Fatty liver syndrome is one of the most critical metabolic disorders observed at the peak productivity in laying hens. The exact cause of the

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<sup>21</sup> Yaremchuk V.Y., Slivinska L.G. (2019). Influence of hepatoprotectors on the functional state of the liver in laying hens with hepatosis. *Science and Education a New Dimension*. Natural and Technical Sciences, VII (26), Issue: 215, Dec.

<sup>22</sup> Gutyj, B.V., Ostapyuk, A.Y., Sobolev, O.I., Vishchur, V.J., Gubash, O.P., Kurtyak, B.M., Kovalskiy, Y.V., Darmohray, L.M., Hunchak, A.V., Tsisaryk, O.Y., Shcherbatyy, A.R., Farionik, T.V., Savchuk, L.B., Palyadichuk, O.R., Hrymak, K. (2019). Cadmium burden impact on morphological and biochemical blood indicators of poultry. *Ukrainian Journal of Ecology*, 9 (1), 235-239.

<sup>23</sup> Остапук А., Гутій Б. (2019). Вплив сульфату кадмію у різних дозах на функціональний стан печінки курей-несучок. *Науковий вісник Львівського національного університету ветеринарної медицини та біотехнологій імені С.З. Гжицького*. Серія: Ветеринарні науки, 21 (94), 103-108.

<sup>24</sup> Tilbrook A.J., Fisher A.D. (2020). Stress, health and the welfare of laying hens. *Animal Production Science*. doi:10.1071/AN19666

<sup>25</sup> Underwood G., Andrews D., Phung T. (2021). Advances in genetic selection and breeder practice improve commercial layer hen welfare. *Animal Production Science* (In press). doi:10.1071/AN20383

<sup>26</sup> Білоконь О.В., Мазуркевич А.Й., Карповський В.І., Трокоз В.О., Криворучко Д.І., Журенко О.В. (2010). Вплив мінеральної кормової добавки «Кормацінк-Р» на обмінні процеси в організмі курей. *Науковий вісник Львівського національного університету ветеринарної медицини та біотехнологій імені С.З. Гжицького*, 12, 2(3), 10-13.

<sup>27</sup> Горжєєв В. М. (2014). Проблеми забезпечення ветеринарного благополуччя тваринництва. *Науковий вісник ветеринарної медицини: збірник наукових праць*. Біла Церква, 13 (108), 5-9.

disease is still unclear, and the first sign is often increased mortality in the herd<sup>28</sup>.

The occurrence of fatty dystrophy, or the so-called fatty liver syndrome, is most often associated with a high intensity of egg-laying<sup>29</sup><sup>30</sup><sup>31</sup>. In addition, probable reasons are the composition and nutritional value of feed (excess energy of feed, content, and origin of feed protein, low level of calcium, with the dominance of a corn diet, with a low level of vitamins E and minerals Zn, Fe, Cu, Mg), inconsistency of the diet with age and physiological the needs of poultry.

Hypovitaminosis of poultry, especially laying hens, are widespread in farms of all forms of ownership and cause significant damage, as they affect immunity, growth, reproduction, laying, and functioning of internal organs, and the nervous system. The normal development of birds and their high productivity depend on them. A-, D-, and E-hypovitaminosis are most typical for laying hens<sup>32</sup>.

A-hypovitaminosis in laying hens is characterized by increased metaplasia and keratinization of epithelial cells of the skin and mucous membranes, impaired vision, and growth of young<sup>33</sup>. In laying hens, the feathers become matted and disheveled, there is general depression, appetite, fatness, live weight, and egg-laying are reduced, the beak and limbs are pale, the skin is dry, mucous discharge from the eyes, serous-mucous exudate is released from the nasal passages<sup>34</sup>. A feature of the

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<sup>28</sup> Dunkley C. Important Nutritional Diseases that Affect Laying Hens <https://www.thepoultrysite.com/articles/important-nutritional-diseases-that-affect-laying-hens>

<sup>29</sup> Lee K., Flegal C. J., and Wolford J. H. (1975). Factors affecting liver fat accumulation and liver haemorrhages associated with fatty liver haemorrhagic syndrome in laying chickens. *Poult. Sci.*, 54, 374-380. doi: 10.3382/ps.0540374.

<sup>30</sup> Hansen R. J., Walzem R. L. (1993). Avian fatty liver hemorrhagic syndrome: a comparative review. *Adv Vet Sci Comp Med.*, 37, 451-468.

<sup>31</sup> Зон Г. А., Ивановська Л. Б. (2016). Дбайте про печінку птиці – досягнете успіху в агробізнесі. *Корми і факти*, 8 (72), 26-28.

<sup>32</sup> Zang H., Zhang K., Ding X., Bai S., Hernández J. M., Yao B. (2011). Effects of different dietary vitamin combinations on the egg quality and vitamin deposition in the whole egg of laying hens. *Braz. J. Poult. Sci.* 13 (3), 189-196. <https://doi.org/10.1590/S1516-635X2011000300005>.

<sup>33</sup> Lima H.J.D. & Souza L.A.Z. (2018). Vitamin A in the diet of laying hens: enrichment of table eggs to prevent nutritional deficiencies in humans. *World's Poultry Science Journal*, 74 (4), 619 – 626.

<sup>34</sup> Raxmonov U.A., Norboev Q.N. (2019). Etiopathogenesis and prevention of hypovitaminosis of chicken. *An International Multidisciplinary Research Journal*, 9 (1), 95-100. DOI : 10.5958/2249-7137.2019.00012.0

symptoms in laying hens is the accumulation of pus-like exudate in the conjunctival sacs and an increase in the sinuses. The yolk contains a low amount of retinol and carotenoids in the eggs they lay.

D-hypovitaminosis is a chronic disease of the poultry of all species, which is accompanied by a violation of calcium-phosphorus metabolism and bone growth. Often, high-performance crosses of laying hens are diagnosed with rickets, which are caused by a deficiency or imbalance of circulating calcium, vitamin D<sub>3</sub>, and phosphorus. In adult birds, D-hypovitaminosis forms osteomalacia and often osteoporosis, decalcifying bones, and eggshells. A lack of vitamin A in the diet and an insufficient ratio of alkaline and acid equivalents are of great importance in the etiology of rickets<sup>35</sup>. According to studies by Vieth (1990), a deficiency of vitamin D<sub>3</sub> in the rations of brood stock often causes rickets in young animals. In addition, an excess of vitamin D can have a toxic effect on the endocrine system and cause several diseases in young animals.

Instead, Jefferson R. (2005) states that the leading causes of osteoporosis and hypocalcemia in chickens are disorders of the hormonal or enzyme systems of the body, the lack of metabolism of secretory products due to the deficiency of the production of a specific enzyme, the destruction or reduction of the activity of the metabolic function, which reduces productivity, egg quality and can lead to the death of the poultry<sup>36</sup>.

Richard J. Julian (2004) emphasizes hypocalcemia in laying hens that died without signs of disease. Still, at autopsy, they were diagnosed with thinning of the femur and absence of medullary bone, an egg without a shell spilled in the oviduct. To prevent osteoporosis, the author recommends providing laying hens with sufficient calcium daily since 2 g of Ca is needed every 24 hours to form an eggshell.

E-hypovitaminosis is a disease that occurs when the body receives insufficient vitamin E (tocopherol) from food and is accompanied by encephalomalacia, myodystrophy, or exudative diathesis. The poultry's

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<sup>35</sup> Turgut L., Hayirli A., Çelebi Ş., Akif Yoruk M., Gul M., Karaoglu M., Macit M. (2006). The effects of vitamin D supplementation to peak-producing hens fed diets differing in fat source and level on laying performance, metabolic profile, and egg quality. *Asian Australasian Journal of Animal Sciences* 19(8), 1179-1189. doi: 10.5713/ajas.2006.

<sup>36</sup> Jefferson R. (2005). Production and growth-related disorders and other metabolic diseases of poultry – A review. *The Veterinary Journal*, 169(3), 350-69. doi:10.1016/j.tvjl.2004.04.015

need for vitamin E depends on the amount and ratio of amino acids in the diet. In addition, hypovitaminosis E occurs when vitamin E is oxidized in tissues, when there is a lack of selenium, sulfur-containing amino acids (methionine, cystine, and others), which have a synergistic effect on tocopherol, prevent its oxidation. The disease occurs when an excess intake of unsaturated fatty acids in the body, which are antagonists of vitamin E and are contained in large quantities in feed fats. E-hypovitaminosis in hens dramatically reduces egg laying, egg fertilization, and chick hatchability. If fertilization occurs, such embryos die on the 3rd–6th day of incubation<sup>37</sup>.

In addition, hypovitaminosis of vitamins of group B and C occur in poultry. They are characterized by damage to the nervous system, muscle atrophy, exhaustion, disruption of protein, fat and carbohydrate metabolism, amino acid metabolism, development of yolk peritonitis, hepatodystrophy, and reduced hatchability, as embryos die at 16–18 days of incubation<sup>38</sup>.

Uric acid diathesis in chickens occurs as a result of a violation of protein metabolism and is characterized by the accumulation of uric acid in the body and the deposition of its salts in organs and tissues<sup>39</sup>. Economic losses from enterprises due to this disease consist of growth retardation of young animals, low payment for feed, loss of body weight, reduction of laying and incubation properties of eggs, death of poultry, and forced slaughter. In addition, perosis, cannibalism, apteriosis and, alopecia, hyperthermia cause damage to poultry farming.

Most often, in farms of different forms of ownership, a combined course of the disease occurs, which in the opinion of scientists, is considered a polymetabolic or polymorbid pathology.

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<sup>37</sup> Panda Arun K. & Cherian Gita (2014). Role of Vitamin E in Counteracting Oxidative Stress in Poultry. *J. Poult. Sci.*, 51, 109-117. doi:10.2141/ jpsa.0130134

<sup>38</sup> Rakonjac S., Bogosavljević-Bošković S., Pavlovski Z., Škrbić Z., Dasković V., Petrović M.D. & V. Petričević (2014). Laying hen rearing systems: a review of major production results and egg quality traits. *Worlds Poultry Science Journal*, 70 (1), 93. doi.org/10.1017/S0043933914000087

<sup>39</sup> Лівощенко С. М., Камбур М. Д., Лівощенко Л. П. (2014). Анатомічні і гематологічні особливості змін при сечокислому діатезі у молодняка курей. *Вісник Сумського національного аграрного університету, серія «Ветеринарна медицина»*, 6 (35), 42-47.



## 2. The influence of metabolic diseases on the quality of hatching eggs and young poultry

Thanks to modern technologies of egg incubation, which ensures a high yield of chicks in conditions of industrial production, poultry farming is rapidly developing both in Ukraine and in the world <sup>40</sup>.

The wide spread of chickens of modern high-yielding egg crosses, mainly of foreign breeding, in Ukraine's poultry farms, leads to negative consequences. Thus, one of the essential problems that must be solved is the development of measures to prevent the deterioration of the quality of hatching eggs and, as a result, the reduction of hatchability. Deterioration of quality indicators is primarily associated with a violation of the morphological and biochemical parameters of the protective bioceramic structures of eggs – the shell and shell membranes, which leads to the fight of eggs, increased waste, and contamination by infectious agents of young birds, a decrease in indicators of immune resistance, a lack or imbalance of certain macro- or trace elements and vitamins, which in turn worsens the quality indicators of products and causes losses to poultry farms, as well as requires constant improvement of incubation technologies.

Eggshell quality remains a constant challenge for the egg industry. The concentration of Ca and P in the diet is a crucial determinant of eggshell strength and weight <sup>41</sup>. The activity of vitamin D<sub>3</sub>, which regulates Ca absorption, is modulated by hydroxylases in the liver and kidneys. In adult birds, reduced renal  $\alpha$ 1-hydroxylase activity is one of the key factors responsible for reduced Ca utilization <sup>42</sup>. The availability of Ca for eggshell formation depends on the size of its particles and the activity of

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<sup>40</sup> Трач В.В., Данчук В.В. (2018). Вплив хімічної обробки інкубаційних яєць на вміст вітамінів А і Е у печінці перепела. Аграрна наука та освіта в умовах євроінтеграції: зб. наук. праць за матеріалами міжнар. наук.-практ. конф. (м. Кам'янець-Подільський, 20–22 бер. 2018 р). Кам'янець-Подільський; 428–430.

<sup>41</sup> Hamilton R.M. (1982) Methods and factors that affect the measurement of egg shell quality. *Poultry Science*, 61, 2022–2039. doi:10.3382/ps.0612022

<sup>42</sup> Li X, Zhang D, Bryden WL (2017) Calcium and phosphorus nutrition of poultry: are modern diets formulated in excess? *Animal Production Science*, 57, 2304–2310. doi:10.1071/AN17389

the stomach. Approximately 65% of calcium entering the body of laying hens should be in the form of coarse particles (> 1–2.5 mm)<sup>43 44 45</sup>.

The quality of eggshells and eggs, in general, are of significant importance to the egg industry worldwide<sup>46 47</sup>. Shell quality is measured by size, specific gravity, shell color, shell breaking strength, deformation (destructive or nondestructive), shell thickness, and shell ultrastructure. The internal quality of eggs is measured by yolk color, membrane integrity, protein quality, and carotenoid content. The quality of the eggshell can be affected by the breed and age of the hens, induced shedding, and feed factors (Calcium, Phosphorus, vitamins, water quality, non-starch polysaccharides, enzymes, feed contamination, stress, maintenance system). Understanding the number of factors that affect the quality of the shell and the internal quality of eggs is essential for producing high-quality hatching eggs and, accordingly, the ordinary course of embryogenesis and healthy young.

Calcium sources and particle size affect shell quality and internal egg quality<sup>48</sup>. Generally, each egg contains up to 3 grams of calcium, and about 95% of the dry shell is calcium carbonate. Therefore, the diet of laying hens should contain a sufficient amount of calcium that can be used

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<sup>43</sup> Rao K.S, Roland D.A (1990). In vivo limestone solubilization in commercial Leghorns: role of dietary calcium level, limestone particle size, in vitro limestone solubility rate, and the calcium status of the hen. *Poultry Science*, 69, 2170–2176. doi:10.3382/ps.0692170

<sup>44</sup> Zhang B., Coon C.N. (1997) The relationship of calcium intake, source, size, solubility in vitro and in vivo, and gizzard limestone retention in laying hens. *Poultry Science*, 76, 1702–1706. doi:10.1093/ps/76.12.1702

<sup>45</sup> Bouvarel I., Nys Y., Lescoat P. (2011) Hen nutrition for sustained egg quality. In 'Improving the safety and quality of eggs and egg products. *Egg chemistry, production and consumption*, 1, 261–299. (Woodhead Publishing: Cambridge, UK). DOI: <https://doi.org/10.1017/S004393391800065X>

<sup>46</sup> Wu Y.B., Ravindran V., Thomas D.G., Birtles M.J., Hendriks W.H. (2004). Influence of method of whole wheat inclusion and xylanase supplementation on the performance, apparent metabolisable energy, digestive tract measurements and gut morphology of broilers. *British Poultry Science*, 45, 385–394. doi:10.1080/00071660410001730888

<sup>47</sup> Yan F., Murugesan G., Cheng H. (2019). Effects of probiotic supplementation on performance traits, bone mineralization, cecal microbial composition, cytokines and corticosterone in laying hens. *Animal*, 13, 33–41. doi:10.1017/S175173111800109X

<sup>48</sup> Guo X. Y., Kim I. H. (2012). Impacts of Limestone Multi-particle Size on Production Performance, Egg Shell Quality, and Egg Quality in Laying Hens. *Asian-Australasian Journal of Animal Sciences*. 25 (6), 839. doi.org/10.5713/ajas.2011.11468

effectively. The primary source of calcium in the diet of laying hens is powdered limestone. Many scientific works are devoted to studying the influence of the size of calcium particles on the quality of the shell and the internal quality of eggs. However, the question of the effect of Ca deficiency and other nutrients on young animals' embryogenesis and quality is still relevant today.

Diseases of embryos cause significant damage to the reproduction of agricultural poultry since any pathological process in the embryo is irreversible. The lag in the growth and development of individual organs is not compensated for, which is why various anomalies arise. In the early stages of development, pathological changes may occur in certain parts of the embryo: necrosis and dystrophy. As a result, agenesis and aplasia (complete absence of implantation of one or another organ) or hypogenesis and hypoplasia (incomplete implantation of an organ) occur. The highest embryonic mortality is observed in the first 5–7 days (about 15%) and especially on the 18–20th day of development (over 50%).

Factors of non-contagious, infectious, mycotic, invasive etiology and violation of the incubation regime can be the causes of embryo development pathology. Non-infectious causes include alimentary (embryonic dystrophies) – due to a lack of protein, vitamins, macro- and microelements; violation of the storage regime of hatching eggs; injuries to egg shells and shells; infringement of the incubation regime – overheating, underheating, increased or decreased air humidity in the incubator, suffocation, incorrect position and movement of eggs; genetic abnormalities.

Hypovitaminosis A, D, E, group B, uric acid diathesis, white muscle disease, perosis, apteriosis, and alopecia are among young birds' most common metabolic disorders from a lack of nutrients in the diet of broodstock.

In young laying hens hatched from eggs biologically inferior in terms of carotene and vitamin A, liquefied fluff on the back and neck, beak and limbs are pale, the slit of the eye is half open, lacrimation and sticking of the eyelids, the umbilical ring is not closed, general depression, inactivity, drowsiness, lack of appetite and nervous phenomena.

The development of rickets in chickens occurs due to the deficiency of hatching eggs in terms of vitamins A and D, excessive humidity in the poultry house, and lack of exercise and green feed in the diet. Rickets most often affects young birds aged 1–5 months. It is characterized by the frailty of chickens, decreased appetite, anemia, and ruffled feathers; the bird sits more and then completely loses the ability to move.

After analyzing the literary sources, we would like to note that the development of egg poultry farming poses to the specialists of veterinary medicine the task of timely diagnosis of diseases of laying hens development of methods of their treatment and prevention.

## **CONCLUSIONS**

Metabolic diseases of laying hens are widespread in farms of all forms of ownership. They require early diagnosis development of methods of group non-specific prevention, in particular of broodstock, to obtain high-quality hatching eggs, reduce economic losses at the stage of embryogenesis, increase hatchability and quality and obtain healthy young highly productive crosses of agricultural poultry.

## **SUMMARY**

Metabolic diseases are the largest group of poultry diseases. They are classified as metabolic diseases, or metabolic diseases, and cause significant economic losses. Laying hens are most often diagnosed with hepatitis, hepatosis, cirrhosis, liver abscesses, cholecystitis, and gallstone disease resulting from impaired carbohydrate, lipid, protein, and mineral metabolism. Lack of calcium, Phosphorus, and vitamin D imbalance in laying hens causes osteoporosis and hypocalcemia. Due to these diseases in chickens, the laying capacity, the quality of hatching eggs, and the hatching of young animals are reduced and can cause the death of embryos and adult livestock. A lack of vitamins A, D, E, and microelements Co, Cu, Zn, and J in poultry leads to a decrease in immunity, reproductive function, laying, disruption of hormonal activity, work of internal organs and the nervous system, and cessation of growth. Hypovitaminosis and microelementosis cause the formation of rotten eggs and the development of alimentary dystrophies in the embryo, affecting the young's hatchability and quality. Therefore, improving the feeding and laying of hens standards is constantly ongoing based on an in-depth study of these processes. The purpose of this work is to conduct a comparative review of the results obtained by various authors regarding the most common metabolic diseases of laying hens, their impact on productive traits (laying), quality characteristics of eggs, embryogenesis, and quality of young of modern high-performance crosses.

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