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PONOMARENKO N., PhD in Agriculture
Bila Tserkva National Agrarian University
ponomarenkon@ukr.net

FEATURES OF PROTEIN METABOLISM IN QUAIL'S PANCREATIC GLANDS IN POSTNATAL PERIOD OF ONTOGENESIS AND UNDER THE INFLUENCE OF NITRATE

Досліджували вміст загального білка та HS-груп, активність ферментів аспаратамінотрансферази, аланінаміно-трансферази і лужної фосфатази у підшлунковій залозі перепелів у постнатальному періоді онтогенезу та за нітратного навантаження. Встановлено онтогенетичні закономірності білкового обміну у підшлунковій залозі, які пов'язані з фізіологічними особливостями росту та розвитку перепелів. За дії нітратів відмічається зниження вмісту загального білка, активності ферментів аспаратамінотрансферази, аланінаміно-трансферази і лужної фосфатази, зростання кількості HS-груп у підшлунковій залозі перепелів.

Ключові слова: білковий обмін, нітратне навантаження, підшлункова залоза, постнатальний період онтогенезу, перепела.

Introduction. Elucidation of physiological and biochemical processes in the pancreas are shown in numbers of dedicated research, but they are not completed with datas of the protein metabolism characteristics in the quail's pancreas. Therefore, it is important to study the characteristics and ontogenetic changes of protein metabolism under the influence of stress factors in quail pancreas. Among the environment pollutants, in terms of the use of nitrate fertilizers forefront. In Ukraine, after a decline in production and use of nitrate fertilizers is increasing, because of the tendency complications environmental situation and the urgency of research related to this problem.

Analysis of recent research and publications. Excessive accumulation of nitrogenous substances in the environment leads to increased nitrate levels in soil, water and fodder plants and, consequently, increases their revenues to the body. Feeding livestock and poultry by feed with high levels of nitrates leads to changes in biochemical parameters in the body, slow performance, the occurrence of poisoning and death [1, 2]. Important role in the mechanism of nitrates action on animals and birds affects the functioning of the gastrointestinal tract. One of the largest gland of the body, which synthesizes hormones and enzymes for protein, nucleic acid, lipid and carbohydrate metabolism is the pancreas [3, 4]. Metabolic changes therein under stress lead to dysfunction of the gastrointestinal tract, hormonal disorders, and as a result – reduce egg performance and live weight of poultry. Enzyme system cells (transferases, phosphatases) which catalyze key reactions of cellular metabolism and localized in organelles, cytosol and plasmolemma are always sensitive in the event of extreme factors on the body. The balance between the number of enzyme molecules in the plasma and in the cells of that exists in the norm, is always changing rapidly under the influence of chemical, physical or biological stressors. Since during stress in cells oxidative phosphorylation becomes slowly, lipid peroxidation is activated, synthesis of some proteins and enzymes is accelerated, albumin synthesis is decreased, permeability of cell membranes is increased, organelles and localized in cytosol are degradating with necrotic process. The increased number of enzymes' molecules comes in, such as plasma of hostrofaznyh proteins, amines, lipids and carbohydrates. Therefore, the performance of enzymes and other compounds in the blood and tissues are reliable criteria for the study of the influence of exogenous factors on the body. Since during stress in cells oxidative phosphorylation becomes slowly, lipid peroxidation is activated, synthesis of some proteins and enzymes is accelerated, albumin synthesis is decreased, permeability of cell membranes is increased, organelles and occurs cytosol are degradating with necrotic process. The increased number of enzymes' molecules comes in plasma, such as phase inflammatory proteins, amines, lipids and carbohydrates. Therefore, the performance of enzymes and other compounds in the blood and tissues are reliable criteria for the study of the influence of exogenous factors on the body [5, 6]. Research in this area is important with the development in Ukraine of new quail industry, that enables the production of dietary products.

The purpose and objectives of the study. To study the content of total protein, SH-groups and activity of aspartate aminotransferase, alanine aminotransferase and alkaline phosphatase in pancreas quail under nitrate load in postnatal ontogenesis.

Materials and Methods. A model experiment was made on breed quails of «Pharaon» kind, which was divided into two groups with 60 goals in each. First group of birds served as a control, second group of birds were given sodium nitrate at a dose of 0,5 g/kg per body weight ranging from 3-day-old with a water. Birds were decapitated under ether anesthesia and biochemical studies performed in the extract of pancreas, ranging from 1-day-old to 10-week with one week intervals. The content of total protein, the number of HS-groups, the activity of the enzymes alanine aminotransferase, aspartate aminotransferase and alkaline phosphatase were determined.

Results and discussion. Research has established that the pancrea's total protein content is quite high during the first four weeks of birds' life (Table. 1). Only in 2 weeks of age it significantly reduced the quantity by 1,7 times as compared to 1-week old chicks, which can be explained by the change of plumage in this period. Until to 9-weeks of age it was marked a downward trend of total protein, which coincides with a period of oviposition. In 9–10-week-old-bird the number of studied parameters is growing again to the level of 3–4 week old quails, indicating a normalization of metabolic processes in the body. The content of HS-groups is also varies up to 4 weeks of age, and subsequently stabilized.

Thiol groups of any biological object is quite labile indicator which can vary under different stress factors. Thiol compounds effectively interact with NO-radicals and nitrogen oxides. Under the influence of oxidation, they reduce the concentration of NO•, S-nitrosoadduktes, formed with them, are unstable and collapsing again lead to the formation of NO•. Thus, nitrogen oxide exhibits sufficiently prolonged action: it is binding of thiols and it can be stored and transported in the body. In addition, thiol compounds induce NO• output of vasodilators such as nitroglycerin and sodium nitroprusside, thereby they are enhancing their pharmacological effect. They stabilize the NO-synthase, protecting it from oxidation of thiol groups of the enzyme. Under conditions of oxidative stress oxidation of HS-groups leads to dangerous for the body suppression coenzymes such as lipoic acid, coenzyme A, glutathione; the work of thiol metaloproteides is undermining, including cytochrome P-450, mitochondrial creatine kinase, a number of hormone receptors and transcription factors.

Table 1 – Content of total protein and HS-groups in the quail's pancreas under the actions of nitrates (M ± m, n = 5)

Age, weeks	Common protein, mg/g		HS-groups, mol/105g	
	Control	Research	Control	Research
1-day old	54,36±4,02	-	38,01±2,27	-
1	84,28±2,10	81,36±4,64	18,60±1,69^	23,72±2,52
2	49,39±2,69^	48,93±2,65	21,85±2,73	21,68±2,74
3	74,84±1,03	61,41±3,73*	6,58±0,83^	17,90±1,77*
4	83,02±3,37	82,88±2,19	25,16±2,94^	24,17±3,35
5	56,38±4,19	42,15±2,14*	29,00±1,85	32,20±3,99
6	38,62±1,35	35,01±2,80	31,32±2,08	28,38±1,97
7	39,56±1,33	36,21±1,36	23,31±2,14	42,58±4,56*
8	38,12±2,20	24,10±1,70*	43,27±5,33	71,65±6,84*
9	57,38±1,76	31,41±1,36*	43,32±2,87	41,61±0,52
10	73,86±2,09	61,72±2,66*	29,81±3,57	33,59±1,81

Note: * – The difference between research and control groups: * – p<0,05; ^ – The difference between previous and next studied periods: ^ – p<0,05

Under nitrate load in pancreas the total protein content decreased throughout the period of study compared to the control group. Thus, a significant reduction in its amount was observed at 3 weeks of age to 25,2 % at 8-10 weeks of 36,7 %, 45,2 % and 16,4 % respectively. The number of HS-groups in pancreas of research birds group increases throughout the period of study compared to the control, and a significant increase was observed at 3 weeks of age by 2,7 times, 7- and 8 weeks of 1,8 and 1,6 times accordingly. This can be explained by an adaptive response to the reduction of total protein in the pancreas nitrate load. The study of enzyme activity has an important role in the diagnosis and

treatment of a variety of diseases [5]. Most enzymes determined in plasma are intracellular and released into the bloodstream when damage cell membranes. Small amounts of intracellular enzymes present in the blood as a result of normal cell renewal. If the damage cells released a large number of enzymes their concentration in the blood increases and decreases respectively in tissues [2, 6]. Ontogenetic changes in activity of aspartate aminotransferase is more dynamic than alanine aminotransferase and alkaline phosphatase. Thus, 1-week age aspartate aminotransferase activity increased 2,2-fold ($p < 0,001$) compared with chicks daily. In the 2-week studied quails activity of the enzyme is reduced by 20,5 % ($p < 0,05$) and maintained at this level up to 6 weeks of age. Since 7 weeks of age there is a tendency to increase the activity of aspartate aminotransferase. The activity of alanine aminotransferase and alkaline phosphatase is kept at a high level to 4 week old quail. At next times of research it was marked reduction in the activity of the studied enzymes.

Under action of nitrates it was observed decreased of aspartate aminotransferase activity in 1-week-old chicks by 16,4 % ($p < 0,05$) and 4-week by 8,0 % ($p < 0,05$). Also, the decrease of alanine aminotransferase activity was admitted in the 2 weeks of age by 28,2 % ($p < 0,05$) in 7- and 8-week 28,0 % ($p < 0,05$) and 27,9 % ($p < 0,05$), respectively, in 10-week to 2,0 times ($p < 0,01$) compared with control. The possible decrease in alkaline phosphatase activity was observed at 2 weeks of age 1,9-fold ($p < 0,01$) in 4-week 1,5-fold ($p < 0,05$) in 7- and 9-week 24,2 % ($p < 0,05$) and 43,3 % ($p < 0,01$), respectively.

Conclusions. Pancreas of quails in postnatal ontogenesis is characterized by specific patterns of protein metabolism that are associated with the physiological characteristics of growth and development. Nitrate loading leads to a decrease in total protein content, the activity of the enzymes aspartate aminotransferase, alanine aminotransferase and alkaline phosphatase, increase in the number of HS-groups. These changes are indicators of protein metabolism, of course, adversely affect the structural and functional state of the pancreas, which leads to gastrointestinal and hormonal disorders, decreased live weight and productivity of poultry.

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Особенности белкового обмена в поджелудочной железе перепелов в постнатальном периоде онтогенеза и при действии нитратов

Н.В. Пономаренко

Исследовали количество общего белка и HS-групп, активность ферментов аспартатаминотрансферазы, аланинаминотрансферазы и щелочной фосфатазы в поджелудочной железе перепелов в постнатальном периоде онтогенеза и при нитратной нагрузке. Установлено онтогенетические закономерности белкового обмена в поджелудочной железе, которые связаны с физиологическими особенностями роста и развития перепелов. При действии нитратов от-

мечается снижение содержания общего белка, активности ферментов аспаратаминотрансферазы, аланинаминотрансферазы и щелочной фосфатазы, увеличение количества HS-групп в поджелудочной железе перепелов.

Ключевые слова: белковый обмен, нитратная нагрузка, поджелудочная железа, постнатальный период онтогенеза, перепела.

Features of protein metabolism in quail's pancreatic glands in postnatal period of ontogenesis and under the influence of nitrate

N. Ponomarenko

The content of total protein and HS-groups, the activity of enzymes aspartate aminotransferase, alanine aminotransferase and alkaline phosphatase in quail pancreas in postnatal ontogenesis and for nitrate load were investigated. Ontogenetic patterns of protein metabolism in the pancreas are established and they are associated with physiological characteristics of growth and development of quail. By action of nitrates there were observed decrease of total protein, activity of enzymes aspartate aminotransferase, alanine aminotransferase and alkaline phosphatase, increase of HS-groups number in the quail's pancreas.

Key words: protein metabolism, nitrate load, pancreas, postnatal ontogenesis of quail.

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