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THE FATTY ACIDS CONTENT IN THE LIVER OF JAPANESE QUAILS AFTER THE CHEMICAL TREATMENT OF HATCHING EGGS

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Abstract. The five groups of Pharaoh quail (100 animals per group) were formed to fulfill the tasks. Quails of the control group were fed by the standard mixed fodder for quail (DSTU 4687:2006). The bird of the research groups (I–IV) received the same feed, but with the addition of 20 g/t of vitamin E. We selected the hatching eggs after 4 weeks of feeding research fodders. Eggs were weighed and laid for incubation using the standard mode after pre-incubation storage of the eggs of the quails obtained in the peak of egg production for 5 days. On the 14th day of incubation, the eggs of the quails were divided into 5 groups. Treatment of eggs I, II and III of the test group was carried out on the 14th day of incubation, respectively, with solutions of 1% sodium hypochlorite 2% perchloric acid 0,5% hydrogen peroxide. Egg of control and IV experimental group were not subject to chemical treatment. The material for research was hatching eggs of quail, liver tissue of 14 daily embryos and 1-day quail. The fatty acid composition of the lipids of tissues and egg yolk was determined in this biological material. Analysis of methyl esters of LC was carried out on a Gas chromatograph Trace GC Ultra (USA) with a flame ionization detector. Identification of fatty acids was carried out using a standard Supelco 37 Component FAME Mix. Quantitative assessment of the spectrum of fatty acids of yolk lipids was carried out by the method of internal normalization, determining their percentage content. Ontogenetic differences in the fatty acid composition of tissues are established. Processing of the eggshell on the fourteenth day of incubation with H_2O_2 solution is accompanied by an increase in the proportion of stearic acid in the liver of the 1-day quail and a decrease in the proportion of Neukosatrienoic and pre-fatty acids. Treatment of the shell with sodium hypochlorite and HCl is accompanied by an increase in the proportion of stearic acid by 0.96–1.00 % and arachinic acid, with a decrease in the proportion of gondoinic and eicosatrienic fatty acids. At the same time, when treating with HCl and sodium hypochlorite, the ratio of the sum of saturated to unsaturated fatty acids decreases by 3.2–7.9% ($p<0.05$). So, the established changes in the fatty acid composition of the liver one-day quail indicate a significant effect of the chemical treatment of the egg shell on the exchange of fatty acids in the embryonic period.

Key words: quail, fatty acids, liver, hydrogen peroxide, sodium hypochlorite, chloride acid.

ВМІСТ ЖИРНИХ КИСЛОТ У ПЕЧІНЦІ ЯПОНСЬКИХ ПЕРЕПЕЛІВ ЗА ХІМІЧНОЇ ОБРОБКИ ІНКУБАЦІЙНИХ ЯЄЦЬ

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Анотація. Для виконання поставлених завдань було сформовано п'ять груп перепелів породи фараон (по 100 птахів у групі). Перепелів контрольної групи годували стандартним комбікормом для перепелів (ДСТУ 4687: 2006). Птахи дослідних груп (I – IV) отримували той самий корм, але з додаванням 20 г/т вітаміну Е. Після 4 тижнів годування дослідних кормів ми відбирали інкубаційні яйця для подальших досліджень. Яйця зважували і викладали для інкубації з використанням стандартного режиму, після попереднього інкубаційного зберігання. На 14-й день інкубації яйця перепелів були розділені на 5 груп. Обробку яєць I, II і III випробуваної групи проводили на 14-й день інкубації відповідно з розчинами 1% гіпохлориту натрію 2% хлорної кислоти 0,5% перекису водню. Яйця контрольної та IV дослідної групи не піддавалися хімічній обробці. Матеріалом для досліджень були яйця перепелів, ембріони перепелів, тканини печінки 14 добових ембріонів і 1-денної перепілки. Визначали жирнокислотний склад ліпідів тканин і яєчний жовток. Аналіз метилових ефірів жирних кислот проводили на газовому хроматографі Trace GC Ultra (США) з полум'яно-іонізаційним детектором. Ідентифікацію жирних кислот здійснювали за допомогою стандартного зразка Supelco 37 Компонент FAME Mix. Кількісну оцінку спектру жирних

кислот ліпідів жовтка проводили методом внутрішньої нормалізації, визначаючи їх відсотковий вміст. Встановлено онтогенетичні відмінності у складі жирних кислот тканин. Обробка яєчної шкаралупи на чотирнадцятий день інкубації розчином H_2O_2 супроводжується збільшенням частки стеаринової кислоти в печінці 1-денного перепела і зменшенням частки полінасичених жирних кислот. Обробка оболонки гіпохлоритом натрію і HCl супроводжується збільшенням частки стеаринової кислоти на 0,96–1,00% і арахінової кислоти при зниженні частки гондоїнової і ейкозатрієнової жирних кислот. У той же час, при лікуванні гіпохлоритом натрію і HCl співвідношення суми насичених і ненасичених жирних кислот зменшується на 3,2–7,9% ($p < 0,05$). Отже, встановлені зміни в жирнокислотному складі печінки одноденних перепелів свідчать про значний вплив хімічної обробки оболонки яйця на обмін жирних кислот в ембріональний період.

Ключові слова: перепели, жирні кислоти, печінка, пероксид гідрогена, гіпохлорид натрію, хлоридна кислота.

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Introduction. Formulation of the problem

The spread of antibiotic-resistant microorganisms in the environment has become a serious environmental problem. The genes for the antibiotic resistance of pathogenic microorganisms are isolated from hospital wastewater, identified in open water bodies, and migratory species also transfer them. This is largely due to the use of large quantities of antimicrobial agents in agricultural production [1-3].

That's why, many countries over the world have banned the use of antibiotics in animal feed, horticulture and crop production, considering not only the accumulation of antimicrobial drugs in food products, but also the spread of antibiotic-resistant organisms in the environment. Poultry farming with its massive poultry treatments remains one of the most significant factors in the spread of multi-drug-resistant strains of pathogenic microorganisms in the ecosystem. The use of chemical and biological methods are an alternative to antibiotics, there are some difficulties though [4-7].

The use of antimicrobial agents is in principle unacceptable in quail breeding operation and obtaining dietary and organic food products. However, there are problems, for example, disinfection of the incubation egg and removal of the cuticle. Moreover, oxidative stress observed in animals and birds in the postnatal period [8,9]. The oxygen supply to the embryo is limited under the conditions of the incubator, therefore the intensity of the shells is less than in natural conditions (the cuticle in the nest is worn out during the incubation period, which ensures a gradual increase in the intensity of the oxygenation of the embryo) [10]. On the other hand, individual pathogens can enter through the egg shells when they come into contact with feces or bird bedding. Thus, sanitation is necessary for the successful production of egg products

Analysis of recent research and publications

There are several methods of sanitizing eggs nowadays: fumigation, spraying, ultraviolet irradiation and washing with disinfectant solutions. In the case when the hatching eggs were not reorganized before incubation, excessive bacterial contamination led to a decrease in hatchability, poor chickens quality, their unsatisfactory growth and reduced productivity in the future [11]. Thus, a promising direction for increasing the hatchability of quails is the removal of the cuticle by various chemical means, further reducing the microbial contamination of the shell surface.

The chemical composition of phospholipids, which are structural components of cell membranes, plays a leading role in their functioning and the course of various processes in cells. In particular, saturated fatty acids (SFA) is the main energy substrate for cardiomyocytes. Due to the ability to increase the unsaturation of the acyl chains of phospholipids, reduce the microviscosity of cell membranes, unsaturated fatty acids (UFA) are an important factor in the regulation of membrane permeability and the functioning of membrane-bound proteins. In addition, certain SFAs are precursors of physiologically active substances – various classes of eicosanoids [12].

The use of chemicals with antibacterial action in eggs incubating is not only damaging the cuticle and increases the intensity of oxygen supply to the embryo, but in parallel with this can have a destructive effect on the ultrastructure membranes' lipid component enhancing peroxidation of acyl polyunsaturated fatty acids (PUFA).

The purpose of research: to study the nature of the influence of the hatching eggs' antibacterial chemical treatment and addition the vitamin supplements to the quail's ration on the fatty acid composition of its tissues at different periods of early ontogenesis.

To achieve this goal, the following **tasks** were solved**:** we studied the ontogenetic changes in the fatty acid composition of quail tissues under the conditions of postnatal oxidative stress when feeding vitamin E on layers; We studied the influence of the chemical treatment of hatching eggs on the fatty acid composition of 1-day quail liver and the ratio of ω-6 / ω-3 polyunsaturated fatty acids.

Research materials and methods

Studies were conducted on the basis of the farm "PE Zabigalyuk" with. Isakovtsy, Kamenetz-Podolsk district of Khmelnytsky region. Microbiological control and determination of fatty acid composition was carried out in the Ukrainian laboratory of quality and safety of agricultural products (ULQSAP) of the National University of Life and Environmental Science of Ukraine, accredited to ISO 17025 within the framework of the state theme of the Ministry of Education and Science of Ukraine (ULQSAP).

The quail content was cellular access to feed and water-free. For experimental studies, eggs, 14-day embryos and 1-day quails (Coturnix japonica) of the pharaoh breed of meat productivity were used. Incubation eggs were selected according to GOST 4656: 2006.

To accomplish the tasks, five groups of quails of the Pharaoh breed were formed (100 animals per group). Control quails were fed standard quail feed (DSTU 4687: 2006). Bird research groups (I-IV) received the same feed, but with the addition of 20 g/t of vitamin E. We selected the incubation eggs after 4 weeks of feeding research feeds. Selected eggs were weighed and laid for incubation using the standard mode after pre-incubation storage of quail eggs obtained at the peak of egg production for 5 days. Quail eggs were divided into 5 groups on the 14th day of incubation. Processing eggs I, II and III of the experimental group was carried out on the 14th day of incubation, respectively, with solutions of 1% sodium hypochlorite 2% perchloric acid 0.5% hydrogen peroxide. The eggs of the control and IV experimental group were not subject to chemical treatment.

The incubation eggs of quails, liver tissue of 14-day embryos and 1-day quails served as material for research. The fatty acid composition of tissue lipids and yolk of eggs was determined in the specified biological material.

Extraction of lipids from yolks of eggs and liver was performed according to the Folch method [13]. The next stage of sample preparation was the hydrolysis and methylation of lipid fatty acids obtained from pooled chicken yolk samples. To do this, up to 100 mg of the obtained fat was added 4 cm3 of sodium hydroxide methyl solution, a reflux condenser was added to a large flask and boiled until the drops of fat disappeared, stirring the contents of the flask at intervals of 30–60 seconds. To the flask, 5 cm^3 of boron trifluoride methyl solution was added, continuing to boil for 1 hour. 3 cm3 of hexane was added to the boiling mixture through the upper part of the reflux condenser and removed from the heating element. 20 cm^3 of a saturated sodium chloride solution was added to the still hot solution and stirred for 15 seconds. The upper (hexane) layer was selected for study [14]. The analysis of methyl esters of LC was performed on a Trace GC Ultra gas chromatograph (USA) with a flame ionization detector. Chromatography conditions: column temperature 140–240°C, detector temperature 260°C. The sample was injected into the chromatograph using the TriPlus autosampler at a dose of 1 µl. The duration of the analysis was 65 minutes

Fatty acids identification was performed using a standard sample of Supelco 37 Component FAME Mix. Quantitative assessment of the fatty acid spectrum of yolk lipids was carried out by the method of internal normalization, determining their content in percent. Studies were conducted in 3 parallels.

Statistical processing of the experimental data was performed by generally accepted methods of variation statistics. The probability of the difference in the indices was estimated by the Student's t-test. The differences between the indicators were compared, considered reliable at a significance level of $p \leq 0.05$.

Results of the research and their discussion

We determined certain ontogenetic features of the quail liver fatty acid composition during postnatal oxidative stress [8]. According to the obtained results (Fig. 1), the saturated fatty acids content (C14:0-C22:0) in the egg yolk and tissues of 14-day embryos differs significantly and varies within fairly wide limits. The egg yolk saturated fatty acids content decreased in the range: palmitic (C16:0)> stearic (C18:0)> myristic (C14:0)> pentadecano (C15: 0)> Begenic (C22:0)> margarine (C17:0)> arachin (C20:0). Whereas this order looked as follows: palmitic (C16:0)> stearin (C18:0)> arachin (C20:0)> myristic (C14:0)> margarine (C17:0) in the liver of embryos and 1-day-old poultry.

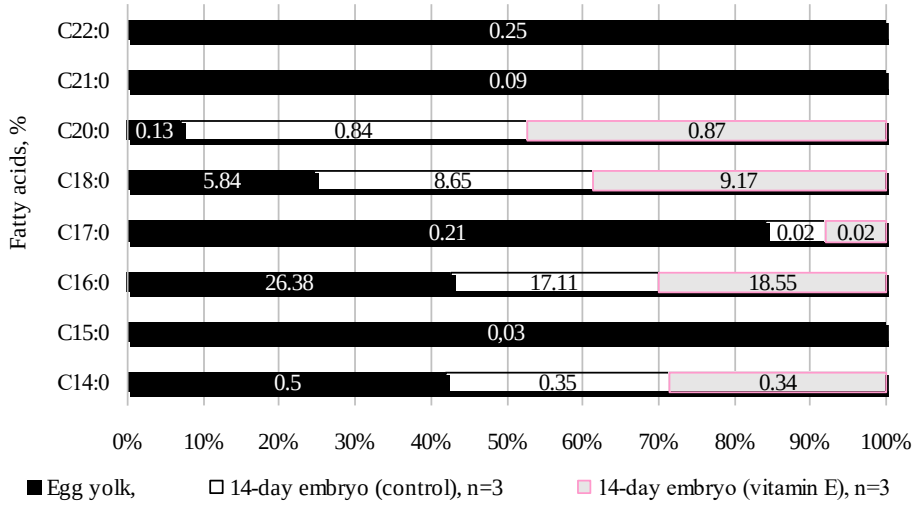

Fig. 1. Saturated fatty acid content in the egg yolk and quail liver

According to the results of the studies conducted by pentadecanoic (C15:0) and Begenic (C22:0) the liver of 14-day-old embryos fatty acids composition and 1-day quails fatty acids composition were not detected; the relative palmitic acid content (C16:0) significantly decreased by 1.54 times, $p < 0.001$, myristic (C14:0) by 1.42 times and margarine acid (C17:0) by 10.5 times, $p < 0.001$, then as the stearic acid content (C18:0) increases significantly (1.48 times, $p < 0.001$). If we compare the embryo liver fatty acid composition and a 1-day quail fatty acid composition, we can note a certain similarity to the content of saturated fatty acids respectively; 0.22, $p < 0.05$. A similar situation was also observed when analyzing the monounsaturated fatty acids content in quail liver and egg yolk (Fig.2).

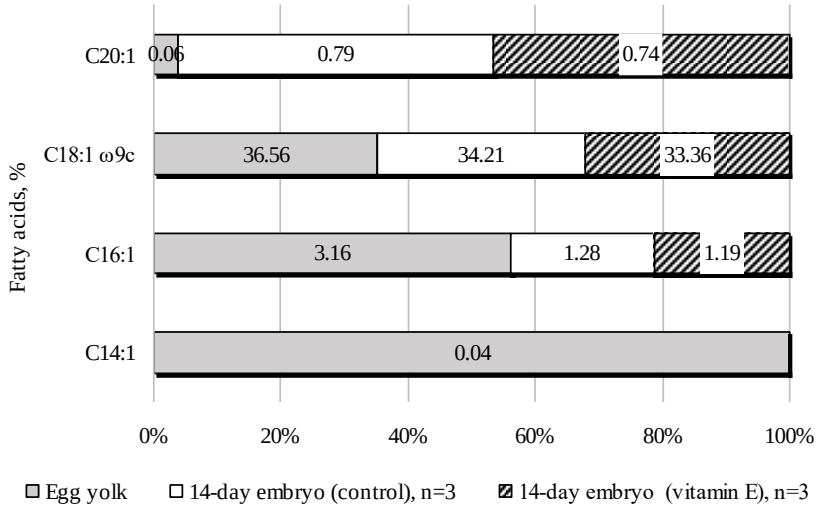

Fig. 2. The monounsaturated fatty acids content in the incubation egg yolk, embryo liver and 1-day quail

The hatching egg yolk monounsaturated fatty acids content decreased in the range: oleic (C18:1)> palmitooleic acid (C16:1)> eicosanoic acid(20:1)> tetradecene acid (14:1). The monounsaturated fatty acids content in the liver of 1-day quail tended to decrease, comparing with indices of the monounsaturated fatty acids content in the 14-day embryo liver tissue under conditions of postnatal oxidative stress. The presence of tetradecenoic acid was not established in the liver of 14-day embryos and 1-day quails, the content of oleic and palmitoleic fatty acids was low, compared to the yolk of hatching eggs, but the concentration of eicosaenic acid increased 10 times (Fig. 3).

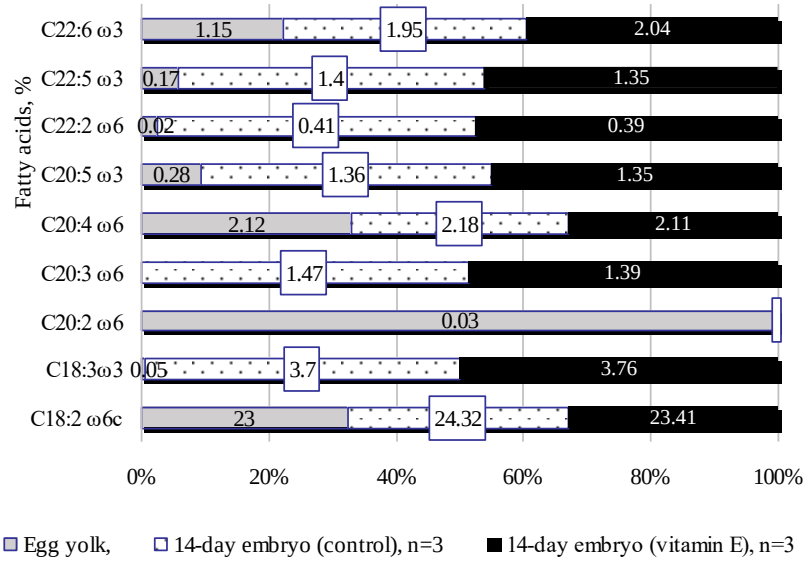

Fig. 3. The polyunsaturated fatty acids content in the incubation egg yolk, embryo liver and 1-day quail

The obtained substantial ontogenetic differences of the polyunsaturated fatty acids contents in quail tissues of different ages indicate the lipid reserves redistribution in the egg during the embryo development and activation enzymatic fatty acid metabolism systems (Fig. 3). Moreover, there are no significant differences in the trend of changes between 14-day quail embryos and 1-day quails, compared with the fatty acid composition of the yolk. It should be noted that after hatching, during the period of postnatal oxidative stress, the content of the chicks in the liver decreases: linoleic (C18:2), arachidonic (C20:4); eicosapentaenoic (C20:5); but there is a slight increase in C20:3ω6; C22:2ω6 and C22:6ω3. Although it should be noted that the percentage indicators are absolutely comparable with the previous stage of research.

Feeding vitamin E supplements to quails contributed to a significant increase of certain unsaturated fatty acids content in the liver of quails at an early stage of ontogenesis, in particular: C22:5ω3 – by 7.7%; C20:3 ω6 – by 17.7%; C16:1 – by 14.8%. At the same time, a slight decrease in the percentage of C16:0 was found – by 1.53% (Table 1).

Table 1 – Fatty acid composition of liver lipids 1-day quail, % (M±m; n=5)

Fatty acids	Control	Vitamin E	H_2O_2 + Vit E	HCl + Vit E	Hypochloride Na+ Vit E
C14:0	0.32±0.01	0.32±0.03	0.35±0.04	0.35±0.04	0.33±0.05
C16:0	17.82±0.22	16.29±0.11*	18.21±0.11	18.87±0.21	18.80±0.26
C16:1	1.22±0.06	1.40±0.07*	1.18±0.09	1.16±0.04	1.19±0.11
C17:0	0.02±0.01	0.02±0.01	0.02±0.01	0.03±0.01	0.02±0.01
C18:0	8.70±0.23	8.32±0.18	9.74±0.27*	9.66±0.08*	9.70±0.25*
C18:1 *ω*9c	33.80±1.16	34.96±0.52	32.71±0.42	32.16±0.12	33.20±0.38
C18:2 *ω*6c	23.89±0.69	23.62±0.11	23.66±0.42	23.64±0.21	22.52±0.07
C20:0	0.81±0.01	0.78±0.13	0.86±0.04	0.88±0.06*	0.88±0.08*
C20:1	0.77±0.06	0.79±0.07	0.75±0.06	0.72±0.10*	0.72±0.10*
C18:3*ω*3	3.69±0.12	3.94±0.16	3.78±0.14	3.84±0.12	3.86±0.11
C20:3*ω*6	1.58±0.10	1.86±0.08*	1.47±0.13*	1.41±0.08*	1.35±0.07*
C20:4*ω*6	2.10±0.02	2.15±0.05	2.10±0.04	2.05±0.06	2.12±0.08
C22:2*ω*6	0.69±0.05	0.71±0.06	0.64±0.06*	0.67±0.06	0.68±0.07
C20:5*ω*3	1.17±0.03	1.19±0.06	1.17±0.05	1.17±0.04	1.15±0.05
C22:5*ω*3	1.42±0.03	1.53±0.10*	1.39±0.05	1.37±0.09	0.40±0.06
C22:6*ω*3	2.04±0.03	2.16±0.08	2.01±0.13	2.07±0.02	2.11±0.08

Notes: data are presented as a mass fraction of fatty acids in% of the amount of fatty acids; ** – P < 0,05 vs control*

Eggshell chemical treatment on the 14th day of incubation affected the one-day quail's liver tissue lipids fatty acid composition. Thus, the eggs treatment with hydrogen peroxide is accompanied by an increase in the proportion of stearic acid by 1.04% ($p < 0.05$) and a significant decrease in the proportion of eicosatrienoic and docosadienoic fatty acids in the amount of 0.11% ($p < 0.05$) and 0.05 % ($p < 0.05$). So, the processing of eggshell with sodium hypochlorite and hydrochloric acid is accompanied by an increase in the proportion of stearic acid by 0.96–1.00% ($P < 0.05$) and Arachinovic acid by 0.07% ($P < 0.05$), while decreasing the proportion of gondoic acid at 0.05% ($p < 0.05$) and eicosatriene fatty acids, respectively, by 0.17% ($p < 0.05$) and 0.23% ($p < 0.05$).

It should be noted a tendency to increase the proportion of myristic, palmitic and linolenic and a decrease in the proportion of palmitoleic, linoleic and docosapentaenoic fatty acids in the liver of one-day quails for chemical processing of eggshell.

Therefore, the polyenzyme systems involved in the fatty acids exchange in the liver of embryos quail reliably reacted to the chemical treatment of the egg shell, as evidenced by changes in the ratio of individual fatty acids. However, it should be noted that the saturated and unsaturated fatty acids total content does not significantly change by the egg shell chemical treatment.

Polyunsaturated fatty acids (PUFAs) are components of the phospholipids of all cell membranes,which regulate the impulse transfer and receptor activity. They also are the precursors of the lipid mediators (eicosanoids) synthesis [8], which are important in the number of physiological processes regulation [12]. There is a clear tendency to reduce the total content of unsaturated fatty acids (by 1,51–2,12%) for the chemical treatment of egg shell. However, if the processing of an incubation egg by a solution of hydrogen peroxide or chloride acid to a greater extent decreases the proportion of monosodium (MLHC) fatty acids by 1.16–1.75%, then the processing of sodium hypochloride solution reduces the total PUFA content (1.39%)

Currenly, there is increasing data on the use of ω-fatty acids for human and animal organisms [15]. Fatty acids ω-6 and ω-3 compete for transformation by enzyme systems and can replace each other [16]. In the presence of a sufficient amount of ω-3 fatty acids, they are rapidly eutrophized in phospholipids and partially replace the fatty acids of the ω-6 family in cell membranes. The chemical egg shell treatment with different substances did not significantly affect the ratio of individual ω-fatty acids in the liver of one-day quail (Fig. 3). It should be noted that only a slight increase in the proportion of ω-3 fatty acids (by 0.2–0.19%) and a decrease in the proportion of ω-6 and ω-9 fatty acids (by 0.38–1.11%).

Reduce of mono- and polyunsaturated fatty acids total content for the chemical egg shells under the treatment by various substances accompanied by an appropriate increase in the proportion of saturated fatty acids in the liver of one-day quail. As a result, the ratio of saturated to the amount of unsaturated fatty acids in the liver of quail increases by 0.03-0.04% (Fig. 3), however, these values are significant only by treatment of chloride acid and sodium hypochloride ($p < 0.05$).

The ratio of ω-6/ω-3 polyunsaturated fatty acids in the liver of one-day quail in all groups is 3.13–3.40: 1. We established the decrease in the ratio of ω-6 / ω-3 fatty acids content in the one-day quail liver under the chemical treatment of quail eggs by different chemicals on the 14th day of incubation. So, the index ω-6/ω-3 decreases in absolute value by 3.2–7.9% ($p < 0.05$) by treatment with chloride acid and sodium hypochlorite. So, the reduce of this indicator by the treatment with hydrogen peroxide is a tendency.

The ratio C18:0 + C18:1/C16:0 (stearic acid + elaidic acid + oleic acid/palmitic acid) is often used in humane medicine in modeling the effects of various xenobiotics on human health [17]. Chemical egg shell treatment with solutions of hydrogen peroxide, sodium hypochlorite and chloride does not significantly affect the C18:0 + C18:1/C16:0 index. Although the tendency towards its decrease (by 2.1–6.7%) is established in the quails liver of the all experimental groups .

Consequently, the established changes in the fatty acid composition in the one-day quails liver indicate the reliable effect of the chemical the egg shell treatment on the fatty acids exchange in the embryonal period.

Approbation of the research results was carried out on the farm "PE Zabigalyuk" with. Isakovtsy, Kamenetz-Podolsk district of Khmelnitsky region (population 5 thousand), According to the results of which quail hatchability was 87–90%.

The research results are recommended for introduction into the specialized farms for the receipt of incubation and marketable eggs and quail carcasses. In order to reduce the intensity of the spread of antibiotic resistant pathogens in the ecosystem and enhance the withdrawal of the quail.

Conclusion

The ontogenetic differences of fatty acid composition of quail tissues have been established. Postnatal oxidation stress causes a decrease of certain unsaturated fatty acids content in the tissues of one-day quail.

The established changes in the liver fatty acid composition of one-day quail indicate the significant effect of the egg shell chemical treatment on the exchange of fatty acids in the embryonic and postnatal period of ontogenesis. We observed the signifcant increase of stearic acid in the liver of a one-day quail and a decrease in the proportion of eicosatriene and dodosadiene acids under the egg shell treatment with a solution of H_2O_2 on the 14th day of incubation. The egg shell treatment with sodium hypochlorite and HCl is accompanied by an increase in the proportion of stearic acid of 0,96–1,00% and of arachidic acid, with a decrease in the proportion of gondoin and eicosatrienoic fatty acids. At the same time, the ratio of saturated to unsaturated fatty acids amount decreases by 3.2–7.9% ($p < 0.05$) under the egg shell treatment with HCl and sodium hypochloride.

List of references:

1. Фещенко Ю.І., Гуменюк М.І., Денісов О.С. Антибіотикорезистентність мікроорганізмів. Стан проблеми та шляхи їх вирішення // Український хіміотерапевтичний журнал. 2010. Т.1. Вип. 23. С. 4-10.
2. Ушкалов В.О., Данчук В.В. Глобальні інтеграційні та комунікаційні засади боротьби з антибіотикорезистентністю мікроорганізмів // Наукові доповіді НУБіП України. 2017. Т. 4. Вип. 68. URL: http://journals.uran.ua/index.php/2223-1609/article/view/112401
3. Косенко М.В., Музика В.П., Косенко Ю.М., Стецько Т.І. Раціональне використання антимікробних препаратів як фактор стримування розвитку антибіотикорезистентності // Ветеринарна медицина України. 2007. № 8. С.40-41.
4. World Health Organization et al. Global action plan on antimicrobial resistance. 2015. 2017. Vol. 978. P. 924.
5. World Health Organization et al. Antimicrobial resistance: global report on surveillance. 2014 // World Health Organization, 256. URL: http://apps.who.int/iris/bitstream/10665/112642/1/9789241564748_eng.pdf
6. World Health Organization et al. Critically important antimicrobials for human medicine: ranking of antimicrobial agents for risk management of antimicrobial resistance due to non-human use. 2017. 48 p. URL: http://www.who.int/iris/handle/10665/255027
7. Mc Nulty K., Soon J. M., Wallace C. A., & Nastasijevic I. Antimicrobial resistance monitoring and surveillance in the meat chain: A report from five countries in the European Union and European Economic Area // Trends in Food Science & Technology. 2016. Vol. 58. P. 1-13.
8. Данчук В.В. Пероксидне окиснення у сільськогосподарських тварин і птиці // Кам'янець-Подільський: Абетка. 2006. 192 с.
9. Снітинський В. В., Дончук В. В., Бучко О. М. Активність антиоксидантних ферментів та інтенсивність процесів вільнорадикального окислення в тканинах свиней у період постнатальної адаптації // Укр. біохім. журнал. 1998. Т. 70. №. 2. С. 105-109.
10. Бреславець В.О., Шоміна Н.В., Князев Ю.Р. Вплив розчинів гіпохлориту натрію та оцтової кислоти на ембріональний розвиток та виводимість яєць курей // Птахівництво. Вип. 2005. № 56. С. 25-35.
11. Scott T.A. Swetnam C. Screening sanitizing agents and methods of application for hatching eggs I. Environmental and user friendliness // J. Appl. Poult. Res. 1993. Vol. 2. P. 1-6.
12. Khyzhnyak S.V., Midyk S.V., Sysoliatin S.V., Voitsitsky V.M. Fatty acids composition of inner mitochondrial membrane of rat cardiomyocytes and hepatocytes during hypoxia- hypercapnia // The Ukrainian Biochemical Journal. 2016. Vol. 88(3). P 92-98. DOI: http://dx.doi.org/10.15407/ubj88.03.092.
13. Folch, J., Leez M., Stanley G. A Simple Method for the Isolation and Purification of Total Lipides from Animal Tissues // J. Biol. Chem. 1957. Vol. 226 (2). P. 497-501.
14. Синяк К.М., Оргель М.Я., Крук В.И. Метод приготовления липидов крови для газохроматографического исследования // Лаб. дело. 1976. № 1. С. 37-41.
15. Смолянінов К. Б., Параняк Р. П., Янович В. Г. Біологічна роль поліненасичених жирних кислот // Біологія тварин. 2002. Т. 4. № 1-2. С. 16-29.
16. Sumegi B., Porpaczy L., Alkonyi I. // Biochim. et Biophys. acta Lipids and Lipid Metab. 1991. Vol. 1081 (2). P. 121-128.
17. Banskalieva V., Sahlu T., Goetsch A. L. Fatty acid composition of goat muscles and fat depots: a review // Small Ruminant Research. 2000. V. 37. P. 255-268.

References:

1. Feshchenko YuI, Humenyuk MI, Denysov OS. Antybiotykorezystentnist' mikroorhanizmiv. Stan problemy ta shlyakhy yiyi vyrishennya. Ukrayins'kyy khimioterapevtychnyy zhurnal. 2010; 1(23):4-10.
2. Ushkalov VA, Danchuk VV. Global integration and communication basics of combating antibiotic resistance of microorganisms. Scientific reports of NULES of Ukraine. 2017; 4(68):1-18. http://journals.uran.ua/index.php/2223-1609/article/view/112401
3. Kosenko MV, Muzyka VP, Kosenko YuM, Stets'ko TI. Ratsional'ne vykorystannya antymikrobnykh preparativ yak faktor strymuvannya rozvytku antybiotykorezystentnosti. Vet. medytsyna Ukrayiny. 2007; 8:40-41.
4. World Health Organization et al. Global action plan on antimicrobial resistance 2015. 2017; 978: 924.
5. World Health Organization et al. Antimicrobial resistance: global report on surveillance. 2014; 256. Available at: http://apps.who.int/iris/bitstream/10665/112642/1/9789241564748_eng.pdf
6. World Health Organization et al. Critically important antimicrobials for human medicine: ranking of antimicrobial agents for risk management of antimicrobial resistance due to non-human use. 2017; 48. http://www.who.int/iris/handle/10665/255027
7. Mc Nulty K, Soon JM, Wallace CA & Nastasijevic I. Antimicrobial resistance monitoring and surveillance in the meat chain: A report from five countries in the European Union and European Economic Area. Trends in Food Science & Technology. 2016; 58:1-13.
8. Danchuk VV. Peroksydne okysnennia u silskohospodarskykh tvaryn i ptytsi. Kamianets-Podilskyi: Abetka. 2006;192.
9. Snitynskyi VV, Donchuk VV, Buchko OM. Aktyvnist antyoksydantnykh fermentiv ta intensyvnist protsesiv vilnoradykalnoho okyslennia v tkanynakh svynei u period postnatalnoi adaptatsii. Ukr. biokhim. zhurnal. 1998; 70 (2):105-109.
10. Breslavets VO, Shomina NV, Kniazev YuR. Vplyv rozchyniv hipokhlorytu natriiu ta otstovoi kysloty na embrionalnyi rozvytok ta vyvodymist yaiets kurei. Kharkiv: Ptakhivnytstvo. 2005; 56:25-35.
11. Scott TA, Swetnam C. Screening sanitizing agents and methods of application for hatching eggs I. Environmental and user friendliness. J. Appl. Poult. Res. 1993; 2:1-6.
12. Khyzhnyak SV, Midyk SV, Sysoliatin SV, Voitsitsky VM. Fatty acids composition of inner mitochondrial membrane of rat cardiomyocytes and hepatocytes during hypoxia-hypercapnia. The Ukrainian Biochemical Journal. 2016; 88 (3):92-98.
13. Folch J, Leez M, Stanley G. A Simple Method for the Isolation and Purification of Total Lipides from Animal Tissues. J. Biol. Chem. 1957; 226 (2):497-501.
14. Cinyak KM, Orgel MYa, Kryk VI. Metod prigotovleniy lipidov krovi dlya gazohromatograficheskogo issledovaniya. Lab. delo. 1976; 1: 37-41.
15. Smolianinov KB, Paraniak RP, Yanovych VH. Biolohichna rol polinenasychenykh zhyrnykh kyslot. Biolohiia tvaryn. 2002; 4(1-2):16-29.
16. Sumegi B, Porpaczy L, Alkonyi I. Biochim. et Biophys. acta Lipids and Lipid Metab. 1991;1081(2):121-128.
17. Banskalieva V, Sahlu T, Goetsch AL. Fatty acid composition of goat muscles and fat depots: a review. Small Ruminant Research. 2000; 37:255-268.

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