DOI 10.32900/2312-8402-2025-135-171-184
UDC 635.5.082.474:60.543.95

INFLUENCE OF PRE-START DIETS WITH LIMITED MINERAL CONTENT ON METABOLISM IN CHICKENS

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Using in-egg feeding, as well as feeding the bird immediately after hatching, it is possible to influence the ability of the adult bird to absorb minerals and other nutrients from feed, its resistance to immunological and oxidative stresses.

In this work, we study the effect of these factors during the first few days after hatching of chicks (reduced norms in the feed of calcium and phosphorus during the first 5 days after hatching). This is the second part of the perinatal period, influencing which it is possible to investigate how they subsequently affect metabolism.

The introduction of nutrients in the second stage of the perinatal period according to appropriate schemes improved the nutritional status of the perinatal chick.

The studies presented in this work are focused on determining the impact of pre-start diets with a limited content of calcium and phosphorus on productive indicators in chickens (live weight during growing and biochemical indicators in blood serum, which would characterize metabolic processes and indicate the intensity with which these processes occur. Based on the results obtained, the following conclusions can be drawn: the impact of pre-start diets with a limited content of calcium and phosphorus, during the second period of perinatal development of the chick (4-5 days after hatching), leads to an increase in the weight of the bird during 14 weeks of life, which is indicated by an increase in the weight of chickens in the experimental groups compared to the control group with a high degree of probability. Analysis of biochemical indicators in the blood serum of chickens indicates that no deviations from the norm were detected, both in the experimental and control groups, but the level of many indicators was significantly higher in the experimental groups compared to the control, and this, in turn, indicates a higher intensity metabolic processes in the body of experimental poultry.

Keywords: pre-starter diets, calcium, phosphorus, blood serum, perinatal nutrition, chickens.

ВПЛИВ ПРЕ-СТАРТОВИХ ДІЄТ З ОБМЕЖЕНИМ ВМІСТОМ МІНЕРАЛІВ НА ОБМІН РЕЧОВИН У КУРЧАТ

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Використовуючи годівлю «в яйце», а також годівлю птиці відразу після виводу, можна впливати на здатність дорослої птиці засвоювати мінерали та інші поживні речовини з кормів, на її стійкість до імунологічних та окислювальних стресів. В цій роботі нами вивчається дія цих факторів протягом перших кількох днів після вилуплення курчат (знижені норми у кормі кальцію та фосфору протягом перших 5 діб після вилуплення). Це друга частина перинатального періоду, впливаючи на яку можна дослідити , як в подальшому вони впливають на обмін речовин.

Введення поживних речовин на другому етапі перинатального періоду за відповідними схемами, покращило харчовий статус перинатального пташеняти.

Дослідження, що представлені в даній роботі зосереджені на визначенні впливу пре-стартових дієт з обмеженим вмістом кальцію та фосфору на продуктивні показники у курчат (живої маси протягом вирощування та біохімічних показників в сироватці крові, які б характеризували обмінні процеси та вказували з якою інтенсивністю ці процеси відбуваються.

Но основі отриманих результатів можна зробити такі висновки: вплив пре-стартових дієт з обмеженим вмістом кальцію та фосфору, протягом другого періоду перинатального розвитку пташеняти (4-5 діб після вилуплення), призводить до підвищення маси птиці протягом 14 тижнів життя, про, що вказує підвищення маси курчат у дослідних групах в порівнянні з контрольною групою з високою часткою вірогідності. Аналіз біохімічних показників у сироватках крові курчат вказує, що відхилень від норми не виявлено, як в дослідних так і в контрольних групах, але рівень багатьох показників був вірогідно вищий у дослідних групах у порівнянні з контрольною, а це в свою чергу, говорить про більш високу інтенсивність метаболічних процесів в організмі піддослідної птиці.

Ключові слова: пре-стартові дієти, кальцій, фосфор, сироватки крові, перинатальне харчування, курчата.

Introduction. Modern agriculture is constantly striving to maximize the biological efficiency of food production, trying to optimize economic indicators, potential profit, increase stability. Commercial poultry farming is one of the most efficient and progressively successful food productions, the stability of which depends on the ability of the poultry company to achieve competitive production indicators. Feed is the most variable component of economic efficiency and profitability, as it accounts for 70 to 80% of the costs of live production. Using "in-egg" feeding, as well as feeding the bird immediately after hatching, it is possible to influence the feed conversion, the ability of the adult bird to assimilate minerals and energy from feed, and its resistance to immunological, environmental and oxidative stresses.

The perinatal period of development covers three days of embryonic development before hatching and several days after hatching. This period is very important for the development of the gastrointestinal tract and the immune system of the bird. Insufficient nutrients in the egg (which can occur due to various factors) can limit the growth and development of embryos. The availability of essential nutrients can be improved, and existing problems can be overcome to some extent by providing in-egg feeding for embryos or early access to feed for young. In addition, the use of nutritional stimuli causes a kind of "programming" of the bird to achieve desired phenotypic traits through modification of nutrition during the perinatal period (Alagawany M. et al., 2020; Alagawany M. et al., 2021; Buyse J. et al., 2020).

Consider the metabolic basis of fetal programming. This is well illustrated by the study and establishment of the increasing incidence of metabolic diseases such as obesity, diabetes and cardiovascular disease, and the interest and investigation of both their genetic and environmental (dietary) basis. It has long been known that maternal nutrition, and therefore the supply of nutrients to the developing oocyte, embryo or fetus, is one of the major environmental factors influencing the development of the offspring. A reliable and balanced supply of amino acids, lipids and carbohydrates is necessary to maintain the high rate of cell proliferation and key developmental processes that occur during the embryonic and fetal stages of life (Andrieux C. et al., 2022 Thanabalan A. et al., 2021). Eukaryotic cells have evolved a complex series of nutrient sensors that are able to regulate gene expression in response to imbalances in nutrient supply. In adults, these systems serve two purposes; first, to protect the cell from damage caused by acute deprivation, and second, to optimize homeostatic control to deal with prolonged excess or deficiency of a particular nutrient. This second process may have critical effects on the long-term health of the offspring. It has been suggested that adverse nutritional conditions during fetal development lead to adaptive changes in metabolism that result in a "thrifty phenotype" in the offspring (Hales C.N. et al., 1992). Poor nutrition in early life causes permanent changes in glucose and insulin metabolism, including reduced insulin secretion and insulin resistance (Hales C.N. et al., 2001). However, if this metabolic programming during embryonic and intrauterine development is inappropriate for the long-term nutritional environment, it can lead to adverse long-term consequences for the offspring (Aihie Sayer A. et al., 2004; Barker D.J., 2004; Yajnik C.S. , 2004). The initiating factors for fetal programming may be nutrients that directly interact with genes and their regulatory elements at the cellular level, altering growth patterns and gene expression.

It is becoming clear that embryonic and fetal cells have a complex system for integrating nutritional signals from the environment and adapting their development accordingly to ensure survival. Available evidence suggests that regulatory systems that sense nutrients are present in many critical tissues during early development (Robertson K.D., 2000; Spiegelman B.M. et al., 2004; Tamashiro, K.L. et al., 2002). It remains to be seen whether they play an important role in establishing homeostatic control mechanisms early in life. (Young L.E. et al., 2001; Young L.E. et al., 2004).

In this phase of our research, we will study the effects of these factors during the first few days after chick hatching. This is the second part of the perinatal period, which can be influenced to change the performance of the bird. Targeted influences during this period can "program" chicks to increase their resistance to immunological, environmental or oxidative stress (Singh A.K., 2019; Spiegelman B.M. et al., 2004). Nutritional programming during the perinatal period can also affect energy and mineral intake, as well as intestinal colonization. For example, Yan et al. (2005) reported that when broilers were fed a diet low in calcium and phosphorus for 90 hours after hatching, they had improved intestinal calcium and phosphorus absorption at 32 days of age and increased gene expression for a mineral transport protein. Angel R. et al. (2008) demonstrated that broilers fed a moderately phosphorus-deficient diet for the first 90 hours after hatching were more tolerant to a P-deficient diet in adulthood and also had higher body weight, better feed conversion.

In an in vitro study using ligated duodenal loops (Morrissey, R.L. et al., 1971) it was observed that broiler chickens absorbed a higher percentage of labeled 47Ca (70 to 90%) when fed diets low in Ca (0.80%) for eight days prior to intestinal sampling, regardless of dietary phosphorus levels, or when fed diets low in phosphorus (0.25%) regardless of dietary calcium levels. Chickens fed a diet with normal P (0.65%) and normal Ca (1.20%) absorbed less than 50% of the 47Ca. Similar work has been done on the adaptation of chickens to diets with limited P and Ca (Angel, R. et al., 2006; Ashwell C. et al., 2010; Tous N. et al., 2024).

These works demonstrate that epigenetic imprinting and dietary adaptation to a diet low in Ca and P are indeed possible and likely also for other minerals (Bar A. et al., 2003; David L. S., 2021). However, there is no data in the literature on the application of nutritional programming on embryos and young laying hens, since the absorption of minerals from feed by laying hens affects not only the health of the bird, but also the quality of eggs, especially the shell.

Thus, the constant development and improvement of technologies have created a new space for research on perinatal nutrition, set new tasks and opened up new opportunities for optimizing the production of poultry products. The introduction of nutrients in the second stage of the perinatal period according to the above schemes has improved the nutritional status of the perinatal chick. However, this issue has not yet been studied sufficiently. Thus, there is no information on this effect on developmental indicators, physiological state and productivity of laying hens.

The use of perinatal feeding techniques in such cases may be promising. Therefore, conducting research in this area is relevant, as it is aimed at increasing the efficiency of production, quality and safety of poultry products in accordance with the requirements of the time.

The purpose of the research is to study the adaptive capacity of poultry through the use of pre-starter diets with a limited content of minerals (calcium and phosphorus), to investigate the impact of these nutritional modifications on the productive performance of chickens and on metabolic processes in the poultry body.

Materials and methods of research. The research was conducted in the Department of Innovative Development of Poultry, as well as in the Department of Quality and Safety Assessment of Poultry Feed and Products and at the Experimental Farm "Preservation of the State Poultry Gene Pool" of the State Scientific and Technological Research Center of the National Academy of Sciences of Ukraine, using as the object of research chickens of the Birkivska Barvysta breed of egg productivity of Ukrainian selection.

The development, selection, and analysis of the components of compound feeds that will be used in research on the formation of pre-starter diets with reduced levels of calcium and phosphorus were carried out.

Using the methods of theoretical generalization and analysis of scientific literature, a list of substances that will be used for poultry feeding was determined.

Recipes of feed mixtures for pre-starter diets with reduced levels of calcium and phosphorus were developed.

The influence of pre-starter diets with a limited content of minerals (calcium, phosphorus) on growth, safety, productive indicators and blood biochemistry indicators in chickens was determined.

To solve this problem, an experiment was conducted on the parent flock of Birkivska Barvysta breed chickens. For this purpose, 3 groups of analogues (60 heads each) were formed from day-old chickens by random sampling. The effect of pre-starter feed with reduced levels of calcium and phosphorus was studied according to the experimental scheme presented in Table 1. Chickens in the control group received complete feed according to the type and age of the bird, the experimental groups during the first 90 hours of life received feed with reduced levels of calcium and phosphorus, then standard feed according to the type and age of the bird. The bird was kept on the floor in compliance with the recommended technological parameters.

Table 1

Experimental design

Group	Diet
1	Complete feed (FC), Ca-1.10; P-0.80
2	FC with Ca-0.80; P-0.50 during the first 90 hours of life
3	FC with Ca-0.60; P-0.40 during the first 90 hours of life

During the growing process, daily bird waste was recorded, live weight was recorded by individually weighing the chickens once every two weeks. Every month, blood was taken (from 10 chickens from the group) for biochemical analysis (determination of hemoglobin, protein, calcium, phosphorus, AsAT, AlAT, alkaline phosphatase, sialic acids, protein fractions in blood serum).

Research results. A study was conducted on the effect of pre-starter feed with reduced levels of calcium and phosphorus on chickens, the experiment was conducted according to the experimental scheme presented in Table 1. Chickens in the control group received complete feed according to the type and age of the bird, the experimental groups received feed with reduced levels of calcium and phosphorus during the first 90 hours of life, and subsequently received standard feed according to the type and age of the bird. The developed recipes are given in Table 2.

Table 2

Recipes for experimental feed for chickens

Number in order	Name of feed	Component content, %		
		control	1	2
1	Corn	35,975	38,375	38,175
2	Wheat	21,000	21,000	21,000
3	Yeast	2,000	2,000	2,000
4	Soybean meal	21,000	21,000	24,400
5	Sunflower meal	12,000	12,000	12,000
6	Fish supplement	3,000	3,000	0,800
7	Bone meal	1,400	0,000	0,000
8	Limestone meal	1,200	1,600	1,200
9	Meat and bone meal	2,000	0,600	0,000
10	Vitamin mixture	0,025	0,025	0,025
11	Trace element mixture	0,050	0,050	0,050
12	Lysine	0,200	0,200	0,200
13	Methionine	0,150	0,150	0,150
	total	**100,0**	**100,0**	**100,0**

	100 g of compound feed contains, %			
1	Metabolic energy, kcal	290,00	290,00	290,00
2	"Crude" protein	20,00	20,00	20,00
3	Ca	1,10	0,80	0,60
4	P	0,80	0,50	0,40
2	"Crude" fiber	4,20	4,20	4,20
6	Lysine	0,10	1,10	1,10
7	Methionine+cystine	0,65	0,65	0,65

Control weighing of chickens was carried out at 2, 4, 6, 8, 10, 12 and 14 weeks of life. An increase in the weight of chickens of the experimental groups compared to the control ones was revealed. The results of weighing and statistical processing are given in Table 3. The survival rate of the livestock in the control and first experimental groups was 96.7%, in the second experimental group it was 98.3%.

Table 3

Dynamics of live weight of chickens, during 14 weeks of life (n=50)

Age of chicks	Indicators	Group of chickens		
		control	1	2
2 weeks	N	45	44	46
	M±m	84,38±5,52	87,91±4,23	93,09±3,56*
	Cv	16,30%	11,86%	9,65%
4 weeks	N	50	50	50
	M±m	171,56±12,57	187,80±9,04*	184,96±15,54
	Cv	19,33%	12,70%	22,17%
6 weeks	N	50	50	50
	M±m	283,24±18,71	301,44±17,92	301,20±18,40*
	Cv	17,43%	15,68%	16,12%
8 weeks	N	50	50	50
	M±m	499,12±26,40	528,88±25,26	529,16±26,48*
	Cv	13,96%	12,60%	13,20%
10 weeks	*N*	*50*	*50*	*50*
	M±m	710,56±39,68	754,80±32,53*	728,08±34,85
	Cv	14,73%	11,37%	12,63%
12 weeks	N	50	50	50
	M±m	915,80±43,27	964,00±36,11*	936,00±38,44
	Cv	12,47%	9,88%	10,84%
14 weeks	N	50	50	50
	M±m	1131,10±52,74	1164,00±41,38	1154,60±37,02
	Cv	12,30%	9,38%	8,46%

*Note. * (p<0.05) compared to control*

Biochemical studies were also conducted, namely, the composition of the blood serum of chickens was determined, those components that may indicate a positive intensification of metabolic processes in the body associated with the metabolic foundations of fetal programming.

We studied the effect of pre-start diets with a limited content of minerals (calcium, phosphorus) on growth and development, survival and blood biochemistry indicators in chickens and obtained the following results (Tables 4-6).

Table 4

Biochemical parameters of blood serum of experimental chickens of 30 days of age (n = 10)

Indicator	Group	Mc±Δm at P=99.0%	Reliability compared to control
Total protein, g/l	**control**	39,00±2,64	
	I	42,50±3,10	p < 0,05
	II	43,20±2,85	p < 0,05
Sialic acids, mmol/l	**control**	1,19±0,25	
	I	1,67±0,35	p < 0,05
	II	1,88±0,36	p < 0,05
AsAT, U/l	**control**	220,14±18,16	
	I	242,08±17,61	p < 0,05
	II	254,44±15,01	p < 0,05
AlAT, U/l	**control**	6,65±2,02	
	I	6,78±2,14	-
	II	6,88±2,22	-
Alkaline phosphatase, U/l	**control**	682,44±60,98	
	I	870,22±67,48	p < 0,05
	II	822,56±62,59	p < 0,05
Hemoglobin, g/l	**control**	110,60±7,92	
	I	110,80±7,61	-
	II	108,80±7,06	-
Calcium, mmol/l	**control**	2,64±0,37	
	I	3,01±0,40	-
	II	2,89±0,33	-
Phosphorus, mmol/l	**control**	1,42±0,35	
	I	1,48±0,34	-
	II	1,51±0,27	-
Albumin, %	**control**	38,24±6,82	
	I	42,41±5,75	-
	II	43,28±8,56	p < 0,05
α_1 - globulin, %	**control**	4,41±0,35	
	I	3,01±0,34	p < 0,05
	II	4,24±0,30	-
α_2 - globulin, %	**control**	18,29±3,59	
	I	17,57±3,33	-
	II	15,31±4,44	-
β - globulin, %	**control**	15,26±2,78	
	I	15,91±3,02	-
	II	17,01±2,86	-
γ - globulin, %	**control**	23,80±3,91	
	I	21,10±3,93	p < 0,05
	II	20,21±4,05	p < 0,05

Table 5

Biochemical parameters of blood serum of experimental chickens of 60 days of age (n = 10)

Indicator	Group	Mc±Δm at P=99.0%	Reliability compared to control
Total protein, g/l	control	42,00±2,92	
	I	44,70±3,09	-
	II	42,80±3,27	-
Sialic acids, mmol/l	control	1,32±0,34	
	I	1,77±0,30	p < 0,05
	II	1,91±0,33	p < 0,05
AsAT, U/l	control	208,95±16,17	
	I	238,15±15,13	p < 0,05
	II	257,71±20,15	p < 0,05
AlAT, U/l	control	7,44±1,95	
	I	7,02±1,99	-
	II	7,32±2,07	-
Alkaline phosphatase, U/l	control	828,54±62,52	
	I	1055,71±68,09	p < 0,05
	II	977,41±65,73	p < 0,05
Hemoglobin, g/l	control	110,40±6,55	
	I	112,60±7,78	-
	II	112,40±5,76	-
Calcium, mmol/l	control	3,69±0,32	
	I	4,86±0,31	p < 0,05
	II	4,21±0,27	p < 0,05
Phosphorus, mmol/l	control	1,97±0,26	
	I	2,00±0,29	-
	II	2,14±0,35	-
Albumin, %	control	44,39±4,22	
	I	46,75±4,04	-
	II	45,75±5,23	-
α_1 - globulin, %	control	2,84±0,41	
	I	3,90±0,38	p < 0,05
	II	3,51±0,39	p < 0,05
α_2 - globulin, %	control	13,83±3,33	
	I	14,75±2,53	-
	II	17,32±3,47	-
β - globulin, %	control	12,49±1,37	
	I	12,89±1,42	-
	II	13,79±1,45	-
γ - globulin, %	control	26,45±2,56	
	I	21,71±3,78	p < 0,05
	II	19,65±3,40	p < 0,05

Table 6

Biochemical parameters of blood serum of experimental chickens of 90 days of age (n = 10)

Indicator	Group	Mc±∆m at P=99.0%	Reliability compared to control
Total protein, g/l	control	38,50±2,70	
	I	47,10±2,56	p < 0,05
	II	44,90±3,72	p < 0,05
Sialic acids, mmol/l	control	1,29±0,29	
	I	1,35±0,29	-
	II	1,30±0,35	-
AsAT, U/l	control	185,66±15,89	
	I	258,69±24,91	p < 0,05
	II	254,62±15,24	p < 0,05
AlAT, U/l	control	8,14±1,93	
	I	8,24±2,33	-
	II	8,88±2,14	-
Alkaline phosphatase, U/l	control	524,72±47,94	
	I	807,59±45,83	p < 0,05
	II	841,24±63,32	p < 0,05
Hemoglobin, g/l	control	125,60±6,28	
	I	130,40±7,40	p < 0,05
	II	128,50±7,12	-
Calcium, mmol/l	control	2,89±0,25	
	I	4,52±0,29	p < 0,05
	II	3,41±0,37	p < 0,05
Phosphorus, mmol/l	control	1,55±0,37	
	I	2,20±0,30	p < 0,05
	II	2,35±0,30	p < 0,05
Albumin, %	control	41,49±4,19	
	I	32,97±4,38	p < 0,05
	II	38,57±4,48	-
α_1 - globulin, %	control	2,90±0,32	
	I	2,47±0,36	-
	II	2,78±0,37	-
α_2 - globulin, %	control	11,58±1,57	
	I	13,20±1,84	-
	II	11,49±1,60	-
β - globulin, %	control	14,57±1,43	
	I	16,34±1,47	p < 0,05
	II	16,16±1,32	p < 0,05
γ - globulin, %	control	29,46±3,93	
	I	35,02±2,18	p < 0,05
	II	31,01±2,76	-

The following changes in the biochemical composition of the blood serum of chickens were found:

- with regard to the content of **total protein**, an increase in its amount was found, significantly ($p<0.05$) at 30, 90 days of life (1 month - control - 39.00±2.64 g/l; experimental groups 42.50±3.10 g/l and 43.20±2.85 g/l; 3 month - control - 38.50±2.70 g/l; experimental groups 47.10±2.56 g/l and 44.90±3.72 g/l, respectively).

- **sialic acids** - the concentration of sialic acids characterizes the state of connective tissue, in blood serum they are bound to proteins and partially to hormones. Their level in the blood serum of the control and experimental groups corresponds to the physiological norm, but compared to the control group, the concentration in the experimental group is significantly ($p<0.05$) higher on the 30.60th day of the study (1 month – control 1.19±0.25 mmol/l, experimental groups - 1.67±0.35 mmol/l and 1.88±0.36 mmol/l; 2 month – control - 1.32±0.34 mmol/l, experimental groups 1.77±0.30 mmol/l and 1.91±0.33 mmol/l, respectively). In our case, this increase is probably associated with the release of N-acetylneuraminic acid (refers to sialic acids) and is a link between the carbohydrate hapten and the protein globule in immunoglobulins and indicates the form in which immunoglobulin molecules are (active or passive), this is also indicated by a significant ($p<0.05$) decrease in the content of gamma globulin in the experimental groups on the 30th and 60th day of the study (1 month control - 23.80±3.91%, experimental groups - 21.10±3.93% and 20.21±4.05%; 2 month - control - 26.45±2.56%, experimental groups - 21.71±3.78% and 19.65±3.40%, respectively).

- liver tests (**AsAT, AlAT, alkaline phosphatase in serum**) their concentrations within the physiological norm. The level of AlAT in blood serum does not differ in groups, AsAT significantly ($p<0.05$) increases in the experimental groups on days 30, 60, 90 (month 1 – control - 220.14±18.16 U/l, experimental groups - 242.08±17.61 U/l and 254.44±15.01 U/l; month 2 – control 208.95±16.17 U/l, experimental groups - 238.15±15.13 U/l and 257.71±20.15 U/l; month 3 – control - 185.66±15.89 U/l, experimental groups - 258.69±24.9 U/l 1 and 254.62±15.24 U/l), this indicates normal liver function, with a more pronounced intensity in the experimental groups. The level of alkaline phosphatase in our studies is within the physiological norm, but if we compare the indicators of the control and experimental groups, we can find the following pattern - the activity of alkaline phosphatase in the blood serum of chickens is significantly higher ($p<0.05$) in the experimental groups compared to the control on the 30th, 60th, 90th day of the study (1 month - control - 682.44±60.98 U/l, experimental groups - 870.22±67.48 U/l and 822.56±62.59 U/l; 2 month - control 828.54±62.52 U/l, experimental groups - 1055.71±68.09 U/l and 977.41±65.73 U/l; 3 month - control - 524.72±47.94 U/l, experimental groups - 807.59±45.83 U/l and 841.24±63.32 U/l). Since alkaline phosphatase is associated with the formation of bone tissue, participates in the transport of phosphorus, and is also a marker of liver dysfunction, participates in lipid metabolism and their transport, it can be concluded that the increased activity of this indicator indicates more intensive metabolic processes in the orgasm of chickens of the experimental groups compared to the control.

- **the content of calcium and phosphorus in the blood serum** of chickens of the control and experimental groups is within the physiological norm. However, if we compare the indicators of the control and experimental groups, we can see that the indicators in the experimental groups are slightly higher than in the control, and for calcium they are significantly ($p<0.05$) higher on the 60th and 90th day (month 2 – control - 3.69±0.32 mmol/l, experimental groups - 4.86±0.31 mmol/l and 4.21±0.27 mmol/l; month 3 – control - 2.89±0.25 mmol/l, experimental groups - 4.52±0.29 mmol/l and 3.41±0.37 mmol/l), for phosphorus on the 90th day of the study (month 3 – control - 1.55±0.37 mmol/l, experimental 2.20±0.30 mmol/l and 2.35±0.30 mmol/l). This suggests that the intensity of metabolic processes in the experimental groups is higher than in the control group and increases with age.

- **the hemoglobin content in the blood** of chickens of the control and experimental groups is practically at the same level during the study on the 30th, 60th, 90th day, only the absolute indicators of hemoglobin content in all groups on the 90th day of the study change (on average by 13%), by the way, the content of beta-globulin (which includes such groups of proteins as hemolexins and transferrins) also correlates with this indicator significantly ($p<0.05$). (3 month - control - 14.57±1.43%, experimental groups 16.34±1.47% and 16.16±1.32%).

- **the albumin content** changes, in the experimental groups it increases by 30 days (1 month - control - 38.24±6.82%, 2nd experimental group 43.28±8.56%) and decreases by 90 days (3rd month - control - 41.49±4.19%, in the first group there is a significant ($p<0.05$) decrease, compared to the control 32.97±4.38%). The albumin content can be used to judge the protein-synthetic function of the liver, the level of plastic proteins in the blood serum. It fluctuates in groups. Since these proteins are synthesized mainly in the liver, when entering the blood plasma, they perform an important function of maintaining the level of water volume between the blood and the intercellular space. Perhaps this process is influenced by some other factors that we do not take into account in this context.

- alpha-1 and alpha-2 globulins fluctuate within normal limits, only on day 60 alpha-1 significantly increases ($p<0.05$), which is probably due to an increase in the level of acidic glycoproteins in the blood serum, i.e. the formation of sialoglycoproteins associated with immunoglobulins. In this case, this increase may occur as a result of the formation of post-vaccination immunity under the influence of live vaccines used in this period of time (2 months - control - 2.84±0.41%, experimental groups - 3.90±0.38% and 3.51±0.39%).

- **the level of gamma globulins** significantly ($p<0.05$) decreases in the blood serum of chickens on the 30th and 60th day of life and is inversely correlated with the level of sialic acids (N-acetyl-neuraminic acid), which indicates an increase in the immune status of chickens of the experimental groups due to changes in the intensity of their action and their structure at the specified age (numerical data are given above in the section "sialic acids"). A significant increase in the concentration of gamma globulins on the 90th day of the study ($p<0.05$) is primarily associated with the use of vaccines at this time and the formation of the final level of post-vaccination immunity in chickens. Judging by the data presented, these processes occur better in the experimental groups than in the control ones (3rd month - control - 29.46±3.93%, 1st experimental group - 35.02±2.18% ($p<0.05$), 2nd experimental group - 31.01±2.76%).

Discussion. Analyzing the biochemical parameters of blood serum in chickens, and comparing the parameters in the control group with the experimental groups, we can conclude that they are within normal limits, but in almost all parameters in the experimental groups they are higher than in the controls, which in turn indicates a greater intensification of metabolic processes in the body, which may be indirectly related to the effect on a complex series of sensors for nutrients that are able to regulate gene expression in response to an imbalance in the supply of nutrients. The initiating factors for programming may be nutrients (reduced levels of calcium and phosphorus in the feed), which may directly interact with genes and their regulatory elements at the cellular level, changing growth patterns and gene expression. We tried to find out whether they play an important role in establishing homeostatic control mechanisms at an early stage of life. This work demonstrates that epigenetic imprinting and dietary adaptation to a diet low in Ca and P are indeed possible. However, we cannot state this unequivocally, since we have investigated only a small spectrum of biochemical and weight parameters. If we compare our studies with those of other authors who cover these processes from a different perspective, we can conclude that we are working in the right direction, which is confirmed by our results.

Based on the conducted studies and the obtained results, the main theoretical principles regarding the influence of pre-starter diets with a limited content of minerals (calcium and phosphorus) on metabolism in poultry are partially outlined.

The theory of the effect of pre-starter diets with a limited mineral content is based on the positive effect of these factors on the metabolic processes in the bird's body, as indicated by the results obtained - an increase in the weight of the bird in the experimental groups compared to the control with a high probability throughout the entire study period, as well as biochemical changes in the blood serum of chickens - which indicate the intensification of metabolic processes, as well as a large number of directions of action, which is confirmed by the above interpretation of the results.

Conclusions:

1. Formulation recipes for pre-starter diets with reduced calcium and phosphorus levels were developed for feeding chickens during the first 90 hours.

2. After weighing at 2, 4, 6, 8, 10, 12, 14 weeks, an increase in the weight of chickens in the experimental groups compared to the control group was detected with a high probability.

3. The survival rate of the livestock in the control and first experimental groups was 96.7%, in the second experimental group 98.3%.

4. Analyzing the biochemical parameters of blood serum in chickens, and comparing the parameters in the control group with the experimental groups, we can conclude that they are within normal limits, but practically the level of all parameters in the experimental groups is higher than in the control, and in many indicators it is probably higher, and this in turn indicates a greater intensification of metabolic processes in the body of chickens in the experimental groups.

5. The obtained data indicate the following trend - the detected changes (increase in the weight of chickens, probable increases in biochemical parameters) may be indirectly related to the impact on a complex series of nutrient sensors that are able to regulate gene expression in response to an imbalance in the intake of nutrients, in this case, reduced levels of calcium and phosphorus in the feed, in the first 5 days of life.

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