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ФИТОБИОТИКИ В РАЦИОНАХ КУР-НЕСУШЕК РАЗЛИЧНЫХ КРОССОВ, ВЛИЯНИЕ ГЕНОТИПА НА ОПЛАТУ КОРМА

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Представлены результаты ввода фитогенных кормовых добавок из местных растительных ресурсов в рационы кур яичного направления продуктивности различных генотипов. Определена степень усвоения (переваримости, использования) питательных веществ корма и конверсия потребленных кормов (затраты корма на 10 шт. яиц и на 1 кг яичной массы). Проанализированы затраты обменной энергии и протеина корма на единицу произведенной продукции. Состав изучаемых фитогенных кормовых добавок: 1,5% (от основного рациона) муки бурых морских водорослей (ламинарии) и 1,5% – муки из местных дикоросов. Установлено, что их применение в рационах кур-несушек способствует интенсификации обменных процессов, происходящих в организме всех генотипов птицы. Усвоение гигровлаги потребленного корма за анализируемые периоды возросло на 2,9–3,6%, переваримость протеина – на 2,9–4,3%, жира – на 3,1–4,0%, БЭВ – на 3,9–4,6%, использование азота – на 4,9–5,9% к контрольным показателям каждого генотипа. Интенсификация обменных процессов способствовала повышению оплаты корма продукцией. Снижение затрат корма на производство 10 шт. яиц составило 5,5–7,3%, на 1 кг яичной массы – 8,4–13,9% к контролю. Уменьшились затраты обменной энергии и протеина корма на производство единицы продукции. В результате анализа полученных данных выявлено, что куры-несушки всех генотипов положительно реагировали на включение в основной рацион биологически активной кормовой добавки. Наиболее «отзывчивым» генотипом (кроссом) на поступление с рационом нутриентов, входящих в состав фитогенной кормовой добавки, является кросс «Декалб Уайт». Птица данного кросса показала наиболее высокие результаты интенсивности обменных процессов организма и оплаты корма продукцией.

Ключевые слова: куры-несушки, кроссы птицы, генотип, кормовые добавки, растительные ресурсы, фитогенные кормовые добавки, обмен веществ, конверсия корма

PHYTOBIOTICS IN THE DIETS OF LAYING HENS OF VARIOUS CROSSES, INFLUENCE OF THE GENOTYPE ON THE PAYMENT OF FORAGE

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The paper presents the results of research on the introduction of phytogenic feed additives from local plant resources in the diets of egg-laying hens of different genotypes. The degree of assimilation (digestibility, use) of the feed nutrients and the conversion of the consumed feed (feed costs per 10 eggs and per 1 kg of egg weight) were determined. The costs of metabolizable energy and protein of feed per unit of production were analyzed. The composition of phytogenic feed additives under study: 1.5% (of the basic diet) flour of brown seaweeds (kelp) and 1.5% - flour of local wild herbs. It was found that their use in the diets of laying hens helps to intensify metabolic processes occurring in the body of all genotypes of poultry. The digestibility of the consumed forage hygroscopic moisture during the periods analyzed increased by 2.9-3.6%, protein digestibility by 2.9-4.3%, fat digestibility by 3.1-4.0%, nitrogen-free extractive substances by 3.9-4.6%, nitrogen use by 4.9-5.9% to the control indices of each genotype. Intensification of metabolic processes contributed to an increase in the payment for feed by products. Reduction of feed expenses for production of 10 eggs amounted to 5,5-7,3%, for 1 kg of egg weight - 8,4-13,9% to the control. The cost of metabolizable energy and protein of feed to produce a unit of product decreased. The

analysis of the data revealed that laying hens of all genotypes responded positively to the inclusion of biologically active feed additive in their basic diet. The most "responsive" genotype (cross) to the intake of nutrients included in the phytogenic feed additive with the diet is the cross "Dekalb White". The birds of this cross showed higher results of intensity of metabolic processes of the body and payment for feed by products.

Keywords: laying hens, poultry crosses, genotype, feed additives, plant resources, phytogenic feed additives, metabolism, feed conversion

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INTRODUCTION

The Decree of the President of the Russian Federation dated 21.01.2020[1] set for agricultural producers the tasks of ensuring food security of the population and reducing the dependence on imports of the state. To meet domestic demand for edible eggs Russian poultry farmers are required to produce at least 45.3 billion eggs per year by 2025 (in 2021 produced 44.9 billion eggs). The implementation of these plans will necessitate an increase in the production of concentrated feed and improving its quality in accordance with the needs of poultry.

The Resolution of the Government of the Russian Federation of 03.09.2021 which includes the subprogram "Development of feed and feed additives for animals"[2] sets the goal of creating a sustainable feed base including the organization of production of feed additives with directed and complex action based on biologically active components which allow increasing the balance of nutrition of agricultural and poultry products. In Russia poultry egg production meets the domestic needs of the population at the expense of its own production. From 2014 to 2017 the increase in gross egg production was more than 3 billion eggs per year. Later on, including 2021, there was almost no increase in egg production. In 2020, the average price of poultry meat was down 5.7% from 2019, but the price of eggs was up 3.8%. Increased egg production and egg quality could help restore the degree of profitability and offset the increase in production costs, which were 20-25% in 2020[3].

In poultry farming there is the highest return on resources spent per unit of production, including feed (2-3 times lower than in pig and cattle breeding), due to which the industry develops confidently and efficiently. Poultry productivity is the main economic and useful trait that has a fairly high degree of variability. In Russia, increasing egg production is carried out by intensive factors: increasing the productivity and safety of poultry, improving the quality and consumer properties of products, as well as increasing the conversion of feed [1].

Of all farm animals, laying hens are the most intensive producers of biologically valuable di-

[1]Decree of the President of the Russian Federation No. 20 of January 21, 2020 "On Approval of the Food Security Doctrine of the Russian Federation".

[2]On Amendments to the Federal Scientific and Technical Program for the Development of Agriculture for 2017-2025. Decree of the Government of the Russian Federation of 03.09.2021, No. 1489, Moscow.

[3]Bobyleva G. A. Save and multiply: an overview of the Russian poultry and egg production sector. URL: https:// www.agbz.ru/articles/obzor-rossiyskogo-sektora-proizvodstva-myasa-ptitsy-i-yaits/ (Accessed on: 15.04.2022).

etary protein. At an annual egg production rate of 250 eggs a hen produces about 875 g of protein per 1 kg of live weight. At the same time, a cow with an annual milk yield of 5000 kg of milk produces only 275 g of protein per 1 kg of live weight. Such high protein production in chickens is possible due to the efficient conversion of protein from the feed they consume into egg protein (20-25%).

In this regard, the provision of laying hens with nutrients and biologically active substances to meet the vital needs of birds and implement the genetically inherent productivity potential must be different than in other farm animals. The increased demand for quality and nutritive value of feed is associated with the physiological properties and features of metabolism in different periods of the life cycle of birds. These include the development of embryos in the confined space of the egg; high growth rate; intensive, decreasing with age, metabolism in young birds; the presence of the pre-lay period, during which there is a restructuring of the body, including biochemical changes affecting all aspects of metabolism; the role of the skeleton in mineral metabolism (performing not only homeostasis functions but also participating in egg formation); the presence of the mechanisms providing nutrient extraction from blood in the ovary and the oviduct, their binding and deposit in the egg elements. Peculiarities of bird digestion are rapid movement of feed through the gastrointestinal tract, insufficient synthesis and limited absorption of endogenous vitamins in the digestive tract. Lack or deficiency of essential nutrients in the diet of laying hens causes metabolic disorders in the body, growth retardation, reduced productivity and product quality[4-6].

Due to the fact that the Russian feed industry is not ready for the production of high-quality complete feeds for the poultry industry, specialists and scientists involved in feeding poultry pay much attention to the use of phytobiotics (plant components) in feeds, and this trend has currently increased.

The problem in feeding poultry is the uncontrolled use of antibiotics. Their excessive use in poultry diets reduces resistance to human pathogens, in the body of which antibiotics are transferred with food. Bacterial resistance and the property of antibiotics to remain in animal products have led to restrictions on the use of antibiotics as growth promoters and feed additives in most developed countries. The use of synthetic antibiotics (AGP) as prophylactic doses in animal feed is banned in the European Union[7] [2, 3].

As an alternative to antibiotics, experts in the field of animal nutrition and nutritionists recommend phytobiotics. Studies have been conducted using phytobiotics in feeding poultry where antimicrobial, antioxidant, anti-inflammatory and stimulating effect of phytobiotics has been confirmed. The antioxidant function of phytobiotics can positively affect the stability of the feed, contribute to the extension of its shelf life. Researchers have proved that the inclusion of phytobiotics in poultry diets has a positive effect on the productivity of poultry and the quality of products (eggs). Studies on stimulation of metabolic processes in laying hens and increasing feed conversion by enriching poultry diets with phytogenic feed additives of different composition have shown positive results[8, 9] [4-11].

The main requirement for the production of edible eggs, along with productivity and prod-

[4]Fisinin V.I., Egorov IA, Droganov I.F. Feeding farm poultry: textbook. Moscow: GEOTAR-Media, 2011. 344 p.

[5]Matyushkin V., Krisanov A., Egorov I. et al. Production of livestock products: textbook. Saransk: Mordovian University Publishers. 2008. pp.157-233.

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[7]EU Regulation, No. 1831/2003.

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uct quality is a high food conversion ratio. Currently, the poultry industry aims to use highly productive genotypes (crosses) of poultry, selected and differentiated according to these requirements. Domestic breeders are studying the possibility of transforming the genetic potential into new breeds, breed groups and poultry crosses. However, due to the lack of a breeding base working with genotypes of the Russian selection, many poultry farms use industrial crosses of laying hens of foreign breeding companies (Isa Brown, Hysex Brown, Hysex White, Dekalb White)[10, 11].

In this regard, specialists engaged in poultry production need information about the effectiveness of a particular poultry genotype for the production of quality products with a high degree of food conversion.

We have conducted studies on the enrichment of laying hens' diets of various foreign crosses (genotypes) with phytogenic biologically active feed additives [12, 13].

The purpose of the study is to determine the genotype of laying hens with the highest degree of digestibility of feed with biologically active substances coming in phytogenic feed additives; to evaluate the food conversion ratio.

The research objectives are to analyze the data obtained from the studies on the use of phytogenic feed additives in the diets of different genotypes of laying hens, to identify the most "responsive" cross of poultry, which has a high degree of food conversion.

MATERIAL AND METHODS

The research was conducted in LLC Poultry farm "Dukchinskaya" (Magadan), on different genotypes of laying hens: "Isa Brown", "Hysex White", "Hysex Brown", "Dekalb White". The use of phytogenic feed additives containing brown seaweed meal (*Laminaria*) and wild-growing herbs meal (composition: common tansy (*Tanacetum vulgare*), common yarrow (*Achilléa millefólium*), narrow-leaved willow-herb (*Chamaenerion angustifolium*), great nettle (*Urtica dioica*) having identical biological activity was studied in feeds.

In the present study, a specific age period of laying hens of the studied crosses - 40-55 weeks - was chosen for analysis. The keeping and feeding conditions of all birds corresponded to the norms recommended by ARRTPI (All-Russian Research and Technological Poultry Institute) and did not differ from each other during the analyzed periods. Experiments on the introduction of feed additives into the diets of different genotypes of laying hens were performed according to a similar scheme (see Table 1).

The composition and nutritive value of the BDs of all laying hens genotypes were in the acceptable range for comparison (see Table 2).

The studies were conducted according to the methodological recommendations[12]. The data were processed using the methods of N.A. Plokhinsky[13]. The results of the studies are presented as a percentage of the control group of each cross (genotype) for the analyzed period.

RESULTS AND DISCUSSION

The use of the studied feed additives in the basic diets of laying hens allowed to enrich the feed with nutrients included in phytobiotics, which helped to stimulate metabolic processes in the poultry organism (see Table 3).

Intensification of metabolic processes of the poultry body increased the productivity of all

[10]Golovkina O.O. Comparative assessment of egg crosses "Highsex Brown" and "Highsex White". Breeding, selection and genetics of farm animals. 2020. URL: http:// azt.vscc.ac.ru/article/28454/ full (accessed on: 15.03.2020).

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[13]Plokhinsky N.A. Guide to biometrics for zootechnicians. Moscow: Kolos, 1969. pp.76-87.

Табл. 1. Схема опытов
Table 1. Scheme of the experiments

Group	Number of birds, heads	Feeding Features
Control	50	BD (basic diet)
Experimental	50	BD + 1.5% flour from kelp + 1.5% flour from local wild herbs

Табл. 2. Состав и питательная ценность основного рациона
Table 2. Composition and nutritional value of the basic diet

Component	Content, %
Wheat	56,88 ± 0,72
Barley	3,94 ± 0,17
Oats	3,84 ± 0,85
Soybean meal	10,25 ± 0,55
Sunflower meal	12,25 ± 0,65
Full fat soybeans	2,66 ± 0,44
Limestone flour + shell flour	10,18 ± 0,09
100 g of mixed fodder contains:	
Metabolic energy, kcal/100 g	246,88 ± 0,89
Crude protein	16,35 ± 0,19
Crude fat	2,21 ± 0,03
Linoleic acid	1,14 ± 0,01

Табл. 3. Усвоение (переваримость, использование) питательных веществ корма, % к контролю
Table 3. Assimilation (digestibility, use) of feed nutrients, % of control

Indicator	"Iza Brown"	"High-sex White"	"High-sex Brown"	"Dekalb White"
Hygro-moisture consumption				
Control	65,3	65,1	64,8	64,9
Experiment	68,2	68,2	67,6	68,5
To the control group	+2,9	+3,1	+2,8	+3,6
Nitrogen used				
Control	41,9	41,6	41,8	41,6
Experiment	47,1	46,5	46,9	47,5
To the control group	+5,2	+4,9	+5,1	+5,9
Crude protein digestibility				
Control	77,2	78,6	79,3	79,9
Experiment	80,6	81,5	82,5	84,2
To the control group	+3,4	+2,9	+3,2	+4,3
Digestibility of raw fat				
Control	75,6	76,2	76,9	81,5
Experiment	78,7	79,9	80,1	85,5
To the control group	+3,1	+3,7	+3,2	+4,0
Digestibility of Nitrogen-free Extractive Substances (NES)				
Control	75,2	76,1	77,3	79,8
Experiment	79,1	80,2	81,7	84,4
To the control group	+3,9	+4,1	+4,4	+4,6

Note. Here and in Tables 4, 5: the control for a bird of each cross (genotype) was a bird of the same cross (genotype) receiving the basic diet.

the studied poultry crosses (genotypes), in connection with this increased food conversion ratio (see Table 4).

As a result of analytical studies, it was found that the introduction of phytogenic feed additives from local plant resources into the diets of laying hens helped to improve the quality and consumer properties of the products (eggs) (see Table 5).

CONCLUSION

It was found that as a result of the use of phytogenic feed additives in the diets of different genotypes of laying hens, the most intense metabolic processes occurred in the body of laying hens of the cross "Dekalb White". There was an increase in productivity, quality of products, as well as the highest degree of food conversion by the laying hens of this genotype. The body of laying hens spent the least amount of

Табл. 4. Основные зоотехнические показатели
Table 4. Main zootechnical indicators

Indicator	"Iza Brown"	"Highsex White"	"Highsex Brown"	"Decalb White"
Performance indicators of laying hens				
Gross egg yield				
Control, pcs.	3571	3685	3654	3701
Experiment, pcs.	3789	3939	3902	3979
To the control group, %	106,1	106,9	106,8	107,5
Oviposition intensity				
Control, %	82,6	82,3	82,9	82,6
Experiment, %	88,5	89,1	89,3	89,7
To the control group (+, –), %	+5,9	+6,8	+6,4	+7,1
Egg mix yield				
Control, kg	166,9	169,3	172,4	173,3
Experiment, kg	185,8	186,9	194,6	202,9
To the control group, %	111,3	110,4	112,9	117,1
Feed conversion				
Feed consumption per 10 eggs				
Control, kg	1,45	1,44	1,46	1,47
Experiment, kg	1,37	1,36	1,37	1,36
To the control group, %	94,5	94,1	93,8	92,7
Feed consumption per 1 kg of egg weight				
Control, kg	2,99	3,10	2,98	2,94
Experiment, kg	2,64	2,77	2,73	2,53
To the control group, %	88,4	89,3	91,6	86,1
ME feed consumption per 10 eggs				
Control, MJ	15,3	15,29	14,92	14,99
Experiment, MJ	14,47	14,40	13,97	13,90
To the control group, %	94,6	94,2	93,6	92,7
ME feed consumption per 1 kg of egg weight				
Control, MJ	24,91	23,99	24,50	24,52
Experiment, MJ	22,00	21,45	22,42	21,06
To the control group, %	88,3	89,4	91,5	85,9
Feed protein consumption per 10 eggs				
Control, g	232	230	234	235
Experiment, g	229	227	231	229
To the control group, %	98,8	98,5	98,9	97,5
Feed protein consumption per 1 kg of egg weight				
Control, g	381	385	382	380
Experiment, g	363	364	353	349
To the control group, %	95,3	94,6	92,5	91,8

Табл. 5. Показатели качества и потребительских свойств яиц
Table 5. Indicators of quality and consumer properties of eggs

Indicator	"Iza Brown"	"Highsex White"	"Highsex Brown"	"Decalb White"
Morphometric indicators of eggs				
Egg weight				
Control, g	57,27**	59,70***	59,10**	59,30***
Experiment, g	58,93***	61,67**	62,94***	63,57***
To the control group, %	102,90	103,30	106,50	107,20
Yolk weight				
Control, g	15,21***	15,37**	15,28**	15,41***
Experiment, g	15,68**	15,82***	15,95***	16,29***
To the control group, %	103,10	102,90	104,40	105,70
Egg white weight				
Control, g	34,50**	34,70***	35,00**	34,90
Experiment, g	36,02***	36,19***	36,72***	36,92**
To the control group, %	104,40	104,30	104,90	105,80
Certified eggs				
Control, %	92,80	92,10	93,80	93,90
Experiment, %	95,90	95,50	97,10	97,70
To the control group (+,–), %	+3,10	+3,40	+3,30	+3,80
Breakage, check				
Control, pcs.	68	68	73	75
Experiment, pcs.	65	66	69	70
Control, %	1,90	1,85	2,00	2,03
Experiment, %	1,72	1,68	1,77	1,76
To the control group (+,–), %	–0,18	–0,17	–0,23	–0,27
Qualitative indicators (content in 100 g of egg weight)				
Dry matter				
Control, g	23,64***	23,71**	23,70**	23,82***
Experiment, g	24,54**	24,28**	24,58***	24,92***
To the control group, %	103,80	102,40	103,70	104,60
Fat				
Control, g	8,42**	8,71***	8,57**	8,61**
Experiment, g	8,65***	9,02**	8,96***	9,05***
To the control group, %	102,70	103,60	104,50	105,10
Protein				
Control, g	10,99***	11,20**	11,21**	11,18**
Experiment, g	11,29**	11,47***	11,67**	11,84***
To the control group, %	102,70	102,40	104,10	105,90
Carotenoids				
Control, μg/g	13,42**	13,18**	13,55***	14,75***
Experiment, μg/g	14,87***	14,46***	15,34**	17,27***
To the control group, %	110,80	109,70	113,20	117,10

** $p \leq 0,01$.
*** $p \leq 0,001$.

feed, metabolic energy and protein for the production of 10 eggs and 1 kg of egg weight.

The genotype of the cross "Dekalb White" was the most "responsive" to dietary enrichment with nutrients contained in the studied phytogenic feed additive from local plant resources (1.5% of kelp meal + 1.5% of meal from local wild fruits in addition to the basic diet).

The results obtained correspond to the goal set for the developers of the cross - to get a bird with high productive qualities and the degree of food conversion. Currently, laying hens of the cross "Dekalb White" are the most promising of the foreign crosses for the production of high quality products with the appropriate payment for feed production.

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