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EFFICIENCY OF USING *ECHINACEA PURPUREA* IN FEEDING LAYING HENS OF A PARENT FLOCK

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Abstract

The main factor in obtaining high-quality hatching eggs is the full balanced feeding of laying hens of the parent flock. In order to study the effect of Echinacea purpurea on the morphological qualities of hatching eggs, a scientific and economic experiment was carried out on laying hens of the parent flock of broilers (it was named as Kobb-500). The birds of the experimental groups were additionally introduced into the feed mixture 1% dry weight of Echinacea purpurea. Evaluation of Kobb-500 chicken eggs at various age periods showed that all morphological indicators of the eggs corresponded to optimal values: protein index - from 7.6 to 8.4%, yolk index - from 39.0 to 42.0%, form index - from 74.9 to 75.3, Howe units - from 82.5 to 84.4 conventional units. In the experiment, a positive effect of Echinacea purpurea on egg mass, shell thickness, and protein index was noted. In general, studies have shown a positive significant effect of Echinacea purpurea on egg morphology and chicken productivity.

***Key words**: cross "Kobb-500", Echinacea purpurea, hatching qualities of eggs.*

INTRODUCTION

The most important element of the technological process in broiler meat production is an efficient system of poultry farming. At the same time, the main factor in obtaining high-quality hatching eggs and increasing the hatchability and viability of young poultry is considered to depend on the balanced feeding (Struk et al., 2013).

Therefore, nowadays it becomes important to increase the reproductive qualities and productivity of poultry with the directed influence of biologically active additives (BAA) on metabolic processes at different periods of poultry breeding. These BAA include various kinds of biological stimulants of plant origin, as well as a number of pharmacological drugs.

In this regard, to obtain premium products, it is safer and more effective to use natural herbal additives (NHA). The positive example of natural herbal additives could be obtained from a plant of the Asteroideae family - *Echinacea purpurea* (Daryin, 2011; Ovchinnikov et al., 2012).

Thus *Echinacea purpurea* was used in our research as NHA to improve the quality of hatching eggs and the productivity of laying hens of the broiler parent flock.

The quality of eggs is one of the main conditions ensuring high incubation productivity. The level of the most important zootechnical indicators (the output of the young poultry and the viability and productivity of the broiler parent flock) depends on the hatching eggs quality (Dyadichkina, 2010). Evaluation of the quality of eggs is the first necessary step for successful incubation.

MATERIALS AND METHODS

Following the aim to examine the effect of *Echinacea purpurea* on the morphological qualities of hatching eggs, a scientific and economic experiment was carried out upon the laying hens of the broiler parent flock from the crossbreed "Kobb-500" poultry in the conditions of the Vasilievskaya Poultry Farm (the Penza region, Russia).

During the experiment the analogue method was conducted and six groups of laying hens with 250 birds in each were formed. In addition, 1% of dry mass experimental groups of *Echinacea purpurea* was added to the daily ratio (compound feed).

In the experiment we used a variety of *Echinacea purpurea* grown in the Scientific

Research Institute of Agriculture (Lunino village, the Penza region, Russia). *Echinacea purpurea* was introduced into daily compound feed by step mixing in a microdoser.

The experimental groups of laying hens were fed a compound feed mixture with the addition of *Echinacea purpurea* from 32 to 45 weeks of age according to the experimental scheme (Table 1). All experimental hens received a plant stimulant with a frequency of 21 days. The first experimental group had been receiving a compound feed mixture with the addition of Echinacea *purpurea* continuously for 7 days, the second - for 6 days, the third - for 5 days, the fourth - for 4 days, the fifth - for 3 days.

Table 1. The experimental scheme

Group	Poultry flock	Feeding Features	Duration of application additives	Frequency, days
Control	250	Main ration (MR)	Constantly	Constantly
1 experimental	250	MR+1 g *Echinacea purpurea* per 100 g of the compound feed mixture	Within 7 days	In 21 days
2 experimental	250	MR+1 g *Echinacea purpurea* per 100 g of the compound feed mixture	Within 6 days	In 21 days
3 experimental	250	MR+1 g *Echinacea purpurea* per 100 g of the compound feed mixture	Within 5 days	In 21 days
4 experimental	250	MR+1 g *Echinacea purpurea* per 100 g of the compound feed mixture	Within 4 days	In 21 days
5 experimental	250	MR+1 g *Echinacea purpurea* per 100 g of the compound feed mixture	Within 3 days	In 21 days

For the experiment, the hatching eggs of the broiler parent flock from the crossbreed "Kobb-500" poultry were used (aged of 32, 38 and 42 weeks of life).

These eggs were evaluated according to the following morphological indicators: egg mass, egg shape index, shell density and thickness, protein and yolk index, Xay index. The definition of these indicators was carried out as follows: the mass of the egg and its components - by weighing on an electronic scale with an accuracy of 0.1 g; density - with the help of saline solutions of various concentrations; shape index - with a trammel; shell thickness – with the special device to determine the shell strain; protein and yolk height – by an altimeter and a trammel, and, according to the data obtained, protein (yolk) index was calculated by dividing its height by the average diameter; the ratio of the protein mass of yolk was obtained by dividing the mass of protein by the mass of yolk; Xay index was defined according to the table using the value of the egg mass (g) and the standing height of the outer dense protein (mm) when pouring the contents of the egg onto a flat glass. The egg production of laying hens was measured daily with the subsequent calculation of egg production for the initial and average layers. The amount of egg mass - was determined as the product of the egg production of the average laying hen and the average egg mass.

The climate parameters of the keeping premises were maintained according to the recommendations for the broiler parent flock from the crossbreed "Kobb-500" poultry. The poultry was kept outdoor using a set of "Roxell" equipment manufactured in Belgium.

RESULTS AND DISCUSSIONS

It is known that the quality of eggs is determined as a result of the total exposure to genetic factors, feeding conditions and poultry keeping.

One of the main indicators of the quality of eggs is their mass. In the experiment, it was noted that as aged the hen as the egg mass increased: at the age of the 32 weeks, the average egg mass in all groups was 59.0 g, at the 38 weeks of age it increased by 4.2 g and at the 45 weeks of age by 7.55 g. The mass of eggs at the beginning of the experiment, at 32 weeks of age, varied slightly from 59.4 to 58.6 g. After six weeks, at the 38 week of age, the mass of eggs from the laying hens of the experimental groups was higher than the same in the control group by 0.36 g. The largest mass of eggs differed in laying hens of the 1st and 4th experimental groups and was 0.8 and 0.9 g, respectively. However, at the 45 week of age, the weight of eggs in poultry groups varied slightly from 66.2 to 66.8 g. Nevertheless, the experimental laying hens retained a tendency to exceed this indicator over the control group by 0.4 g.

It was noted that with the age of the bird and the increase in egg weight on average for all groups of birds, the relative protein content decreased from 63.9% at the 32 week of age to 61.8% at the 38 week and to 61.3% at the 45 week of life. At the same time, the experimental group exceeded the control counterparts by this indicator at the 32 week of age by 0.6%, at the 38 week of age by 0.1% and at the 45 week of age by 1.7%. With a relative decrease in protein content with age of the poultry, the yolk content increased. At the 32 week of age, the relative yolk content was 25.5%, at the 38 week of age - 29.4% and at the 45 week of age - 30.0%.

At the 32 week of life, the highest relative yolk content was observed in the 1st and 2nd experimental groups of 25.7 and 25.8%, which is higher than the control group by 0.3 and 0.4%, resp. ($P<0.05$). At the 38 weeks of age, the highest relative yolk content was also observed in the 1st and 2nd experimental groups of 30.1 and 29.8%, which is higher than the control group by 0.4 ($P<0.05$) and 0.1% resp. At the 45 week of life, the highest relative yolk content 31.7% was detected in the control group. The data obtained indicates that as the egg mass increases as to the yolk content increases and the protein content decreases, which affects their ratio.

Table 2. The ratio of the eggs components from the experimental laying hens, M±m, %

Indicator	Group					
	Control	1 experimental	2 experimental	3 experimental	4 experimental	5 experimental
At the 32 week of life						
The mass of eggs, g	59.2±0.5	59.2±0.5	59.0±0.7	58.6±0.5	59.4±0.5	58.7±0.7
Protein	63.4±0.1	63.6±0.2	63.6±0.2	64.2±0.1	64.1±0.1	64.5±0.2
Yolk	25.4±0.1	25.7±0.1	25.8±0.1	25.2±0.1	25.6±0.1	25.5±0.1
Shell	11.2±0.1	10.7±0.13	10.6±0.1	10.6±0.11	10.3±0.12	10.0±0.12
At the 38 week of life						
The mass of eggs, g	62.9±0.4	63.7±0.4	63.5±0.4	62.4±0.4	63.8±0.4	62.9±0.4
Protein	61.7±0.1	61.3±0.1	61.6±0.1	61.8±0.1	62.1±0.1	62.3±0.1
Yolk	29.7±0.1	30.1±0.2	29.8±0.2	28.3±0.1	29.3±0.2	29.2±0.2
Shell	8.6±0.1	8.6±0.08	8.6±0.09	9.9±0.1	8.6±0.1	8.5±0.09
At the 45 week of life						
The mass of eggs, g	66.2±0.4	66.7±0.4	66.7±0.4	66.4±0.4	66.5±0.4	66.8±0.4
Protein	59.9±0.2	62.2±0.2	61.5±0.2	61.3±0.2	61.4±0.2	61.8±0.2
Yolk	31.7±0.1	29.4±0.1	30.0±0.1	29.9±0.1	29.8±0.1	29.1±0.1
Shell	8.4±0.08	8.4±0.1	8.5±0.1	8.8±0.09	8.8±0.08	9.1±0.1

In the experiment, it was noted that with an increase in the egg mass, the absolute shell mass changed insignificantly. In this regard, the relative mass of the shell with the age of the poultry and increasing in the mass of the egg gradually decreased. So, at the 32 week of life, the relative shell mass was 10.6%, at the 38 week of age - 8.8% and at the 45 week of age - 8.7%.

The thickness of the shell mainly determines its strength and resistance to mechanical destruction. At the 32 week of life, the thickness of the shell ranged from 355.9 to 362.0 microns. In general, from the experimental flock, the egg shell was 4.1 microns thicker compared to the control group ($P<0.001$). The eggs of the first experimental group of 362.0 μm differed in the largest shell thickness, which is 6.1 μm more than that of the control analogues ($P<0.001$). At the 38 week of age, the thickness of the shell on average for all groups increased by 15.2 microns and amounted to 374.5 microns. The birds of the 3rd and 4th experimental groups differed in the largest shell thickness, while the excess over the control group was 9.5 and 10.5 μm, respectively ($P<0.001$). At the age of 45 weeks, the shell thickness on average for all groups was 362.5 μm, which turned out to be 12 μm lower than the average shell thickness at the 38-week-old bird ($P<0.001$). However, even at this age, the experimental poultry was defined by the largest shell thickness in comparison with the control group. Among all the experimental groups, the largest shell thickness was observed in the 4th and 5th experimental groups, while the superiority over the control group was 15.3 and 17.3 μm ($P<0.001$).

The egg quality is also characterized by the density of the egg, which defines the freshness of the egg and determines the quality of the shell. During the current research, it was noted that the egg density decreased with age. At the 32 week of life, the egg density was 1.081, at the 38 week - 1.074 and at the 45 week - 1.070 g/cm^3. The experimental group had the higher egg density at the 32 and 38 weeks of life compared with the control group of laying hens. However, the similar results were not observed at the 45 week of life. The diameter of the air chamber is negatively correlated with the egg density. Analyzing the experimental data, it was generally noted that with a decrease in the egg density, the diameter of the air chamber increased. At the 32 week of age, the laying hens with the egg density of 1.081 g/cm^3, the diameter of the air chamber was 1.95 mm, at the 38 week of life with the egg density of 1.074 g/cm^3, the diameter of the air chamber was 2.2 mm and at the 45 week of life with the egg density of 1.070 g/cm^3, the diameter of the air chamber is 2.3 mm.

The egg shape is an important quality indicator, as it significantly affects the position of the embryo during its development, as well as the damage of the shell in the process of collection, transportation and hatching. The most accurate indicator of the shape is the shape index, which normally should be 74-78% for non-calibrated eggs. The higher the egg shape index - the more rounded the eggs, and the lower the egg shape index - the more extended and elongated eggs.

At the 32 week of age, the form index for all analyzed groups was 77.08, at the 38 week - 78.41 and at the 45 week - 77.88. In this case, the tendency to increase the shape index with an increase in egg mass was noted.

The quality of the contents of the egg is characterized by the indices of protein and yolk. The yolk index of the hatching eggs ranged from 44.12-44.81% and remained virtually unchanged during the reproductive period. At 32 weeks of age, it was 44.23%, at 38 weeks of age - 44.67%, and at 45 weeks of age - 44.34%.

One of the indicators of the egg quality is the protein index, which in the experiment was characterized by relative stability. This indicator amounted to 6.86% at the 32nd week of life, and 7.16% at the 38th and 45th weeks of life, which corresponds to normative indicators.

Regarding the indicators of the protein quality, the Xay index has the highest relationship with its index, since both of these indicators are determined on the basis of measuring the height of the dense protein layer. The optimal values of the Xay index for hatching eggs are 65-87. Analyzing the obtained data, it could be found out that during the reproductive period this indicator was in the range of 74.3–82.0 conventional units (Table 3). At the 32 week of age this indicator was 74.3, at the 38 week - 78.5, and at the 45 week - 82.0 conventional units.

Table 3. Indicators of egg density, shape index, diameter of the air chamber and shell thickness of the experimental laying hens, M±m

Indicator	Group					
	Control	1 experimental	2 experimental	3 experimental	4 experimental	5 experimental
At the 32 week of life						
The density of the egg, g/cm^3	1.080± 0.001	1.081± 0.001	1.080± 0.001	1.080± 0.001	1.081±0.001	1.087± 0.001
Air diameter cameras, mm	1.95± 0.03	2.00± 0.04	1.97± 0.03	1.99± 0.03	1.80± 0.03	1.99± 0.04
Shell thickness, microns	355.9± 0.5	362.0± 0.7	358.0± 0.6	360.9± 0.5	360.0± 0.7	359.0± 0.7
Index of the form,%	76.39± 0.43	77.16± 0.17	77.22± 0.18	77.90± 0.43	77.36± 0.17	76.42± 0.18
At the 38 week of life						
The density of the egg, g/cm^3	1.072± 0.001	1.072± 0.001	1.074± 0.001	1.075± 0.001	1.074± 0.001	1.075± 0.001
Air diameter cameras, mm	2.20± 0.03	2.20± 0.03	2.21± 0.03	2.21± 0.03	2.21± 0.03	2.20± 0.03
Shell thickness, microns	368.6± 1.0	372.1± 0.6	373.1± 0.6	378.1± 0.9	379.1± 0.6	376.1± 0.5
Index of the form,%	78.55± 0.23	78.08± 0.25	78.40± 0.24	78.53± 0.23	78.40± 0.26	78.50± 0.24
At the 45 week of life						
The density of the egg, g/cm^3	1.071± 0.001	1.068± 0.001	1.070± 0.001	1.069± 0.001	1.069± 0.001	1.071± 0.001
Air diameter cameras, mm	2.29± 0.02	2.29± 0.02	2.31± 0.02	2.29± 0.02	2.30± 0.03	2.29± 0.02
Shell thickness, microns	350.8± 0.8	362.1± 0.9	363.1± 0.9	364.9± 0.8	366.1± 0.9	368.1± 0.9
Index of the form,%	77.15± 0.18	77.86± 0.18	78.06± 0.18	77.82± 0.17	77.93± 0.19	77.94± 0.18

The most important indicator of laying hens of the broiler parent flock is the egg production. The highest egg productivity for the entire accounting period from 32 to 45 weeks of age was observed in the poultry of the experimental groups, which averaged 1374 eggs, which is 64 eggs higher than the data of the control group ($P<0.01$). The poultry of the 2nd and 4th experimental groups had the highest egg productivity, while the superiority over the control group was 72 and 74 eggs resp. In the calculation of the average laying hen, the egg production in the control group was 74 eggs, in the 2nd and 4th experimental groups there were 3.7 and 4.6 eggs more ($P<0.01$).

Table 4. Productivity and safety of laying hens in the experimental groups

Indicator	Group					
	Control	1 experimental	2 experimental	3 experimental	4 experimental	5 experimental
Egg laying of the initial laying hen, eggs	73.4	76.2	77.4	77.3	77.5	76.4
Egg laying of the average laying hen, eggs	74.2	77.9	77.9	77.8	78.8	77.1
Gross egg collection by group	1310.9	1360.3	1382.9	1380.6	1384.4	1363.8
Preservation,%	97.77	95.54	98.63	98.91	96.23	97.89

CONCLUSIONS

Thus, the assessment of eggs upon the laying hens of the broiler parent flock from the crossbreed "Kobb-500" poultry at different age periods showed that all morphological indicators of the eggs corresponded to the optimal values: protein index - from 7.6 to 8.4%, yolk index - from 39.0 to 42, 0%, egg shape index - from 74.9 to 75.3, Xay index - from 82.5 to 84.4 conventional units. In the experiment, a positive effect of *Echinacea purpurea* on the egg mass, shell thickness, and protein index was noted. Also revealed a significant effect of *Echinacea purpurea* on the egg productivity of the experimental poultry.

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