Qualitative indicators of incubation eggs by using domestic vitamin E in nutrition of “Hisex Brown” cross chickens

M I Slozhenkina, Z B Komarova, T V Voronina, A V Rudkovskaya and D V Friesen
Volga Region Research Institute of Manufacture and Processing of Meat-and-Milk Production, Volgograd, Russia

E-mail: niimmp@mail.ru

Abstract. For the normal functioning of the reproductive system, vitamin E, which protects sperm, egg yolk, and embryo organs from oxidation, is a necessary component of the diet of the bird. Given the role of vitamin E in the life of the body, the authors studied the degree of influence of the new feed supplement Innovit E 60, created in Russia by the specialists of Group of Companies “MEGAMIX”, which has no analogues in the world, on the quality indicators of chicken’s hatching eggs of the cross “Hisex Brown”. In experiments, it was found that the biochemical composition of the hatching eggs of the experimental group improved slightly. The level of dry matter and protein in the yolk of eggs tended to increase by 0.28 and 0.26%, and mineral substances - by 0.02%, in all likelihood due to the content of bioavailable silicon in the feed additive. The vitamin composition of the yolk improved: carotenoids by 18.18% (P <0.05), vitamin A - by 19.18% (P <0.05), vitamin E - by 42.4% (P <0.01). A similar picture was observed when determining the composition of the protein, in which the dry matter content increased by 0.19%, protein - by 0.06 and carbohydrates - by 0.12. A significant difference in the concentration of vitamin B2 in the protein part of the hatching eggs was found to be 11.67% (P <0.05). There was a significant decrease in acid number in the eggs of the experimental group by 10.24% (P <0.01). It was proved that the feed supplement Innovit E 60 due to its higher activity had a significant effect on the quality of incubation eggs.

1. Introduction

Vitamin E is widespread in nature, with the richest sources being vegetable oils, cereal products, legumes, and generally green plants. In nature, the synthesis of vitamin E is a function of plants, and, therefore, their products are the main source of its entry into the animal organism [1, 2].

DL-alpha-tocopheryl acetate is the most common form of vitamin E used to feed animals and birds to protect carotene and other oxidizing agents in the diet and body. It is widely known and recognized as one of the most effective natural antioxidants [3].

α-tocopherol has the strongest protective effect of all the antioxidants studied to date. Integrating into the phospholipid bilayer membrane, tocopherols inhibit the development of lipid peroxidation, and this prevents the contact of oxygen with unsaturated membrane lipids [4]. There is a lot of evidence that the vitamin in the body affects the biosynthesis of DNA in cells, and is of particular importance for the cellular respiration of the heart and skeletal muscles [5, 6].

Vitamin E has several different functions. It is necessary for the integrity and optimal function of the reproductive system [7, 8, 9].
Vitamin E stimulates the effect on the functional activity of reproductive glands of birds, which contributes to the normal course of the process of egg formation, egg protection and the elimination of organisms from the body, which contributes to better absorption of the remaining fat-soluble vitamins that are involved in the metabolism of all common and biologically active substances [10, 11].

An insufficient amount of vitamins in the parents diet leads to low withdrawal and high embryonic mortality at the last stage of incubation due to injuries occurring in the cardiovascular system of the embryo [12].

In recent decades, synthetic vitamin E was not produced on the territory of the Russian Federation, and domestic agricultural producers were forced to purchase it abroad. The first feed vitamin E (Innovit E 60) produced in Russia by the Group of Companies “MEGAMIX” is E-acetate (DL-alpha-tocopheryl acetate) with an activity of 60-63%, as an excipient (carrier) silicon dioxide.

In this regard, the task was set to study, in a comparative aspect, the effect of the new feed supplement Innovit E 60 (Russia) and vitamin E BASF (Germany) on the qualitative indicators of hatching eggs of the cross “Hisex Brown”. To solve the problem in terms of pedigree reproducers II order JV "Svetly" of the Volgograd region was conducted scientific and economic experience. For the experiment, two groups of hens of the parent flock at the age of 30 weeks were formed. The bird of the control group received a general farm ration (RR), in the premix of which contained vitamin E BASF, in a dosage that corresponded to standard indicators, the bird of the experimental group as a part of the premix received the feed additive Innovit E 60 in the same dosage.

2. Results and discussion

As a result of studies, it was found that the studied feed additive had a positive effect on the biochemical composition of the hatching eggs of the experimental group (table 1).

| Indicators                  | control          | experimental     |
|-----------------------------|------------------|------------------|
| Contained in yolk           |                  |                  |
| Dry matter, %               | 51.10±0.39       | 51.38±0.23       |
| Protein, %                  | 16.73±0.41       | 16.99±0.27       |
| Fat, %                      | 32.21±0.17       | 32.17±0.21       |
| Carbohydrates, %            | 1.09±0.05        | 1.13±0.07        |
| Mineral matter, %           | 1.07±0.02        | 1.09±0.03        |
| Carotenoids, mkg/g          | 17.60±0.94       | 20.80±1.02*      |
| Vitamin A, mkg/g            | 8.13±0.47        | 9.69±0.34*       |
| Vitamin B2, mkg/g           | 6.61±0.11        | 6.89±0.17        |
| Acid index, mg/KOH          | 3.12±0.08        | 2.83±0.06*       |
| Contained in protein        |                  |                  |
| Dry matter, %               | 11.98±0.08       | 12.17±0.07       |
| Protein, %                  | 10.68±0.06       | 10.74±0.05       |
| Carbohydrates, %            | 0.77±0.06        | 0.89±0.04        |
| Mineral matter, %           | 0.53±0.03        | 0.54±0.03        |
| Vitamin B2, mkg/g           | 3.34±0.10        | 3.73±0.09*       |

Note here and in table 3: * — p<0.05 and ** — p<0.01.

The level of dry matter and protein in the yolk of eggs tended to increase by 0.28 and 0.26%, and mineral substances - by 0.02%, in all likelihood due to the content of bioavailable silicon in the feed additive. The vitamin composition of the yolk improved: carotenoids by 18.18% (P <0.05), vitamin A - by 19.18% (P <0.05), vitamin E - by 42.4% (P <0.01). A similar picture was observed when determining the composition of the protein part of the egg, in which the dry matter content increased by 0.19%, protein - by 0.06, and carbohydrates - by 0.12. A significant difference in the concentration of vitamin
B2 in the protein part of the hatching eggs was found to be 11.67% (P <0.05). There was a significant decrease in acid number in the eggs of the experimental group by 10.24% (P <0.01).

In the course of the experiment, weekly, for 35 days, the concentration of vitamin E in the hatching eggs of the experimental groups was determined. The research results depending on the period of feeding the studied vitamin preparations are presented in table 2.

Table 2. The concentration of vitamin E in hatching eggs, mg / 100 g (n = 3).

| Groups       | Feeding period, days |
|--------------|----------------------|
|              | 7        | 14       | 21      | 28      | 35      |
| Control      | 1.25±0.046| 1.27±0.032| 1.28±0.027| 1.24±0.036| 1.25±0.043|
| Experimental | 1.38±0.039| 1.41±0.029*| 1.45±0.041*| 1.53±0.044**| 1.78±0.065**|

In the control group, throughout the entire period of the experiment, the vitamin E content in the hatching eggs remained approximately at the same level and amounted to 1.24-1.28 mg / 100 g, which is lower than the normative values. In the experimental group, an increase in the level of vitamin E in hatching eggs was observed after 7 days of feeding the vitamin preparation Innovit E 60 by 10.40% with an unreliable difference. After 14 days of feeding the study drug, a significant difference was established between the control and experimental groups, which amounted to 11.02% (P <0.05), after 21 days - 13.28% (P <0.05), after 28 days - 23.39% (P <0.01), and after 35 days - 42.40% (P <0.01). By the end of the experiment, after 35 days of feeding the Innovit E 60 feed supplement, the vitamin E content in the hatching eggs was 1.78 mg / 100 g, which is close to the recommended standards (2.00 mg / 100 g).

Before incubation, a morphological analysis of eggs was carried out, which showed that the weight of the eggs of the experimental group tended to increase by 0.53% compared with the control, and the protein mass to yolk mass ratio approached the standard values and amounted to 1.90 against 1.92 in control. The protein index in the experimental group was higher than in the control group by 0.47% (P <0.05), and the number of Haugh unit was 1.49% (P <0.05).

At the end of the experiment, the eggs were incubated in the experimental groups (table 3).

Table 3. Egg incubation results.

| Indicators                          | control | % | experimental | % |
|------------------------------------|---------|---|--------------|---|
| Eggs hatched into an incubator      | 560     | 100| 560          | 100 |
| Fertile eggs                       | 526     | 93.93| 531          | 94.82 |
| Incubation waste, of which:        |         |    |              |    |
| Infertiles                         | 34      | 6.07| 29           | 5.18 |
| Blood ring                         | 22      | 3.93| 19           | 3.39 |
| Dead-in-shell                      | 26      | 4.64| 20           | 3.57 |
| Addle egg                          | 17      | 3.04| 11           | 1.96 |
| Bred young birds, head             | 461     | -  | 481          | - |
| Hatched healthy chickens, %        | -       | 82.32| -            | 85.89 |
| Egg hatchability, %                | -       | 87.67| -            | 90.58 |

As a result of incubation in the experimental group, a higher daily output of young birds was obtained, which amounted to 85.89%, which exceeded the same indicator in the control group by 3.60%.

As expected, an increase in chickens was mainly due to an increase in the number of fertilized eggs by 0.89 and a decrease in embryo death in the last days of incubation (on hatch) to 1.08%.
3. Conclusion
It has been experimentally proved that the feed supplement Innovit E 60, due to its higher activity compared to vitamin E (BASF), had a significant impact on the quality of incubation eggs, the concentration of vitamins, especially vitamin E, and, as a result, the output of healthy daily young birds.

Acknowledgments
This work was carried out as part of a grant from the President of the Russian Federation НШ-2542.2020.11.

References
[1] Gorlov I F, Slozhenkina M I, Komarova Z B, Tkacheva I V, Krotova O E, Struk A N, Friesen V G, Nozhnik D N, Ivanov S M, Friesen D V and Rudkovskaya A V 2019 The effect of biological supplements of natural origin on metabolism of parent flock hens Jornal of Pharmaceutical Sciences and Research 11(4) 1629-32
[2] Traber M G, Mah E, Leonard S W, et al 2017 Metabolic syndrome increases dietary α-tocopherol requirements as assessed using urinary and plasma vitamin E catabolites: a double-blind, crossover clinical trial. Am J Clin Nutr 105 571-9
[3] Gaur S, Kuchan M J, Lai C S, et al 2017 Supplementation with RRR- or all-rac-α-tocopherol differentially affects the α-tocopherol stereoisomer profile in the milk and plasma of lactating women. J Nutr. 147 1301-7
[4] Sandul P A and Sobolev D T 2018 Dynamics of transaminase activity in broiler chickens when using a drug containing L-carnitine and alpha-tocopherol Veterinary Pharmacological Bulletin 4(5) 94-100
[5] Dalólio F S, Albino L F T, Lima H J D, Silva N J and Moreira J 2015 Heat stress and vitamin E in diets for broilers as a mitigating measure. Acta Scientiarum 37(4) 419-27
[6] Joris P J and Mensink R P 2015 Effects of supplementation with the fat-soluble vitamins E and D on fasting flow-mediated vasodilation in adults: a meta-analysis of randomized controlled trials. Nutrients 7 1728-43
[7] Gorlov I F, Komarova Z B, Struck A N, Andreev P S and Berko T V 2015 The effect of the drug “Baksin-KD” on the reproductive properties of roosters and hens of the parent flock of the cross “Highsex brown” Bulletin of the Lower Volga Agro-University Complex: science and higher professional education 2(38) 128-32
[8] Ivanov S M, Komarova Z B, Berko T V and Struck A N 2016 Qualitative indicators of hatching eggs when using the parental herd of pumpkin meal enriched with a bioavailable form of iodine in poultry diets Bulletin of the Lower Volga Agricultural University: science and higher professional education 1(41) 141-8
[9] Kavtarashvili A Sh, Koentsova V M, Maso V M et al 2017 Chicken egg biofortification: vitamins and carotenoids Agricultural Biology 52(6) 1094-104
[10] Dysken M W, Sano M, Asthana S, et al 2014 Effect of vitamin E and memantine on functional decline in Alzheimer disease: the TEAM-AD VA cooperative randomized trial JAMA 311 33-44
[11] Ivanov S M, Komarova Z B, Berko T V and Struk A N 2016 Qualitative indicators of incubation eggs when using in the birds of the parent stock of pumpkin pump, enriched with a bioavailable form of iodine News of the Lower Volga Agricultural University: Science and higher professional education 1(41) 141-8
[12] Surai P F and Sparks N H 2000 Tissue-specific fatty acid and alpha-tocopherol profiles in male chickens depending on dietary tuna oil and vitamin E provision Poultry Science 79 1132-42