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Research Article

ANTIOXIDANT PROPERTIES OF ETHANOLAMINE, SUCCINIC ACID AND SERINE WHEN TREATING HATCHING EGGS

Yartseva Inessa Sergeevna[1]*, Azarnova Tatiana Olegovna[2], Indyukhova Yevgeniya Nicolaevna[1], Kochish Ivan Ivanovich[3], Naydensky Mark Semenovich[3]

[1]Student. Moscow, Suzdalskaya Street

[2]Doctor of Science (D.S.), Degree in Biology, Ph.D., Docent in the Chemistry Department, Moscow, Plyuschev Street

[3]Doctor of Science (D.S.), Degree in Agriculture, Professor in the Animal Hygiene Department, Moscow, Scriabin Street

***Correspondence**

Yartseva Inessa Sergeevna

Student. Moscow, Suzdalskaya Street

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Abstract

The aim is to study the effect of a solution of ethanolamine, succinic acid and serine on the development of broiler chickens, their blood chemistry, egg hatchability and the hatching of chicks. By participating in biological oxidation reactions and also, probably, the more effective creation, primarily, of phospholipid membranes, the application of a complex solution of ethanolamine, succinic acid and serine led to the production of young with higher anti-oxidant capacities, high natural resistance and hence the improved viability of individuals. The hatching of the experimental group was 84.4 % vs. 9.4 % for the control group. The following biochemical parameters of the poults' blood were obtained: peroxidase and superoxide dismutase increased in SOD by 70 % and in peroxidases by 1.2 times, respectively, but Schiff bases and malondialdehyde decreased by 30 % and 10 %, respectively.

Keywords: chickens, embryogenesis, antioxidants, ethanolamine, succinic acid, serine.

INTRODUCTION

Commercial poultry production is inherently accompanied by stresses, whose adverse impact leads to a reduction in the viability and productivity of agricultural poultry. For this reason, special attention must be paid to the development of effective measures and drugs with comprehensive effects that are capable of minimising the adverse consequences of stressors. Free-radical reactions play no small part in the development of stress. Excessive generation of active species facilitates damage, first and foremost, to the phospholipid bi layer membrane. This results in an increase in intensity of lipid peroxidation of lipids. As a result, a large number of both new forms of free radicals and also mutagenic and cytotoxic substances are created in the cell, in the form of malondialdehyde, Schiff bases and numerous others, which are capable of triggering endocrine and carcinogenic pathologies. Furthermore, by interfering with metabolic processes, these active species and lipid peroxidation products facilitate the development of hypoenergetic conditions, which are particularly dangerous for intensively developing embryos, whose demand for adenosine triphosphate (ATP) is especially high. These conditions are caused both by disruption of the mitochondrial respiratory chain, which is the chain most sensitive to stress, of glycolysis, and also indirectly of the Krebs cycle (KC).[1-3] In light of the above, we believe special attention should be given to the prophylaxis of hypoenergetic conditions and of the destructive phenomena in the phospholipid membrane, both of which occur under stress, via the use of natural metabolites. For this purpose the following metabolites were chosen: Ethanolamine - a component of phospholipids, in particular of certain plasmalogens and cephalins that can also be converted into both choline and lecithin. Moreover, on being converted into choline, ethanolamine has the ability through the cofactor flavine adenine dinucleotide (FAD) to support the mitochondrial respiratory chain function, inhibiting its energy losses.[4] It is generally recognised that a metabolite requires energy substrates for its effective conversion. By experiment we chose succinic acid for this purpose, since it can participate in biological oxidation, the Krebs cycle and in certain extremely important syntheses (haem, etc.)[5] Serine was selected as the third component of the complex. In the breakdown process this amino acid is subject to direct or indirect deamination with the formation of pyruvic acid, which is subsequently included in the Krebs cycle. Furthermore, serine is a member of another class of phospholipids – phosphatidylserine.[6] Thus in our opinion the proposed complex should definitely hinder the destructive phenomena in the cell membrane and preserve energy synthesis in the mitochondrial respiratory chain, as well as maintain the intensity of the Krebs cycle (Figure 1).[6]

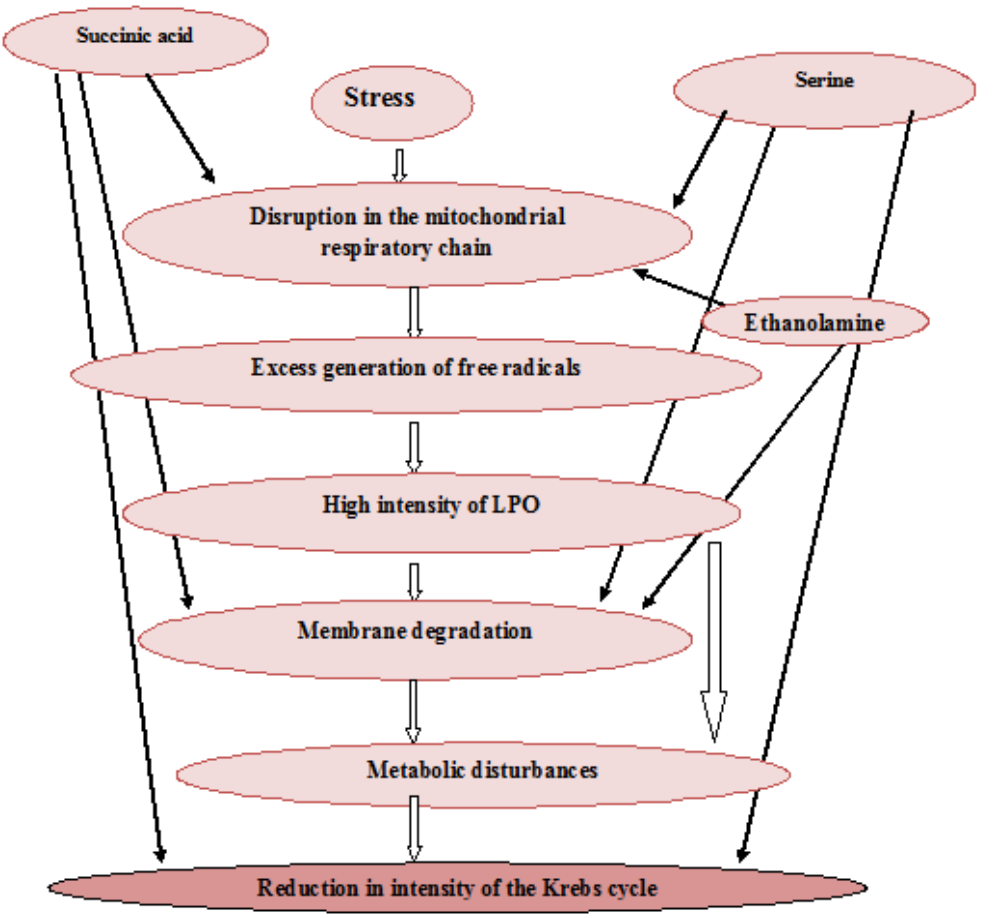

Figure 1: Scheme of the prophylactic effect of ethanolamine, succinic acid and serine during stress

MATERIAL AND METHODS

The experiments were carried out at the Ptichnoe closed joint-stock company. This research was carried out on incubated eggs and day-old chicks of the Shaver Brown egg cross. The experimental groups were irrigated with a spray gun prior to incubation and for the nineteen days of incubation, but the control groups were not given any processing with medication. Biochemical and zoo technical parameters were measured according to standard procedures.[7-8]

RESULTS AND DISCUSSION

The chicks were weighed during the first days after hatching and the acreage weight of the experimental group exceeded the control group by 6.5 g. (Figure 2)

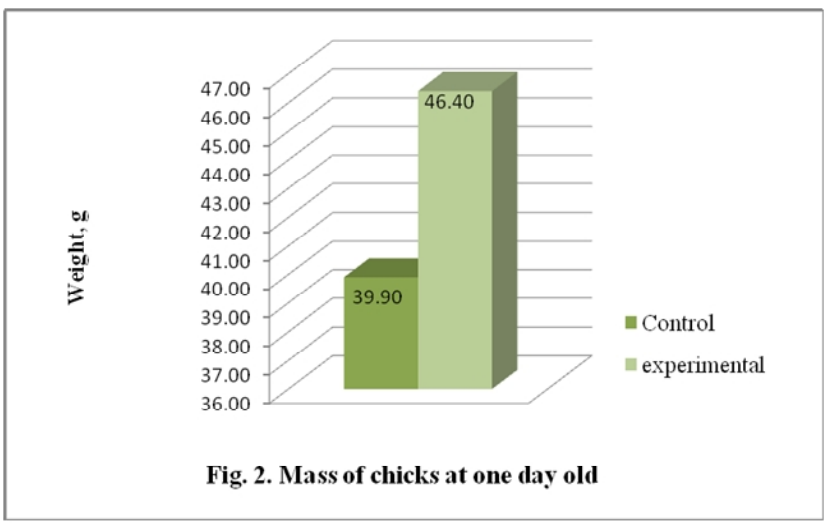

Fig. 2. Mass of chicks at one day old

Our results were confirmed by studying the lipid peroxidation (LPO) indicators in one-day-old chicks of the Shaver Brown egg cross.

To determine the intensity of the processes of peroxidation and anti oxidation activity in blood plasma, blood was taken from the wing vein of day-old chicks to carry out biochemical screening. It was determined that the intensity of lipid peroxidation in the experimental group was lower than that of the control group. The secondary product level of lipid peroxidation in the form of malondialdehyde (MDA) was reduced by 10 % and the end-product in the form of Schiff bases (SB) by 30 %, in comparison with the control group. Given the reduction in LPO intensity, the antioxidant enzymatic protection of the chicks increased, which manifested itself in an increase of 70 % in SOD and 20 % in peroxidases. The above application exerted a stimulating effect on metabolism. Our study of the central indices of certain metabolic rates noted a tendency towards the stimulation of protein, carbohydrate and phospholipid metabolism. The total protein content in the blood plasma of chicks in the experimental groups rose by 5.4 %, α-amylase by 7.9 %, blood glucose by 2.2 %, phosphatidylcholine by 40 % and phosphatidylserine by 30 % in comparison with the control. It is important to note that the intensity obtained was optimum for these chicks, since in the experimental group the activity of the index for natural resistance – lysozyme – rose by 4.8 %. The high anti-oxidant capacities of the chicks, together with the optimisation of their metabolism, stimulated the haematological factors in the blood. Of particular note is that in the blood of day-old chicks of the experimental group a trend was established of an increase in haemoglobin of 2.5 %, haematocrits of 3.1 %, and the red blood count of 1.9 %, with a reduction in the erythrocyte sedimentation rate (ESR) of 2.7 %. The positive developments noted above had a substantial effect on the incubation bio control indices (Table 1).

Table 1: Incubation Biocontrol Markers, % n = 544

Group	Neo fetus	Blood rings	Still fetus	Addled eggs	Weaklings	Hatchability	±Δ	Hatching	±Δ
Control	7.72 ± 1.14	2.76 ± 0.70	8.27 ± 1.18	3.86 ± 0.83	2.39 ± 0.65	81.27 ± 1.67	-----	75.00 ± 1.86	-----
Experimental	6.80 ± 1.08	1.29 ± 0.48	3.68 ± 0.81	1.84 ± 0.58	2.02 ± 0.60	90.53 ± 1.26***	+ 9.26	84.38 ± 1.56***	+ 9.38

Note: here and below * - $p < 0.05$, ** - $p < 0.01$, *** - $p < 0.001$

Compared with previous research[4], all categories of incubation waste in the experimental groups were much lower than in the control group. Thus it was established that the hatching of chicks and egg hatchability were higher than in the control group by 9.38 % and by 9.26 % respectively. This was caused by a reduction in the experimental group of such incubation losses as: “blood ring” by 5.6 times, “dead-in-shell” by 2.2 times, “addled” by 2 times, and “weaklings” by 0.4 %.

CONCLUSIONS

In view of the foregoing, it may be concluded that the complex of serine, ethanolamine and succinic acid has clear metabolism-stimulating, membrane protection and anti-oxidant properties, which are a guarantee of high natural resistance, and hence of the viability of the young.

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