ON THE INFLUENCE OF NATURAL BIOLOGICALLY ACTIVE SUBSTANCES ON THE MAIN BIOCHEMICAL PARAMETERS OF BLOOD

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Abstract. In the study of the effect of extracts made from medicinal plants of the families *Asteráceae (Compósitae)* and *Lamiaceae (Labiatae)* and amyloyodine on the main biochemical parameters of blood (protein, albumin, total globulin, albumin-globulin ratio, glucose, triglycerides, cholesterol, the ratio of albumins to the number of globulins per unit of blood volume, the triglycerides-glucose index (TyG) and the ratio of triglycerides to cholesterol – (Ty/Cs) it was revealed that the use of these means contributes to the accumulation of energy resources and activation of metabolism with simultaneous saving of energy costs (despite the period of active growth); increase in the hydrophilicity of tissues, due to which the transportation of cations, anions, bilirubin, bile salts, vitamins, and some fatty acids is more intensive; an increase in the level of globulins, which contributes to more intensive immunization (hence a speedy recovery) and intensification of the protein-synthesizing function of the liver, as a result of which there is a faster synthesis and transfer of hormones. The TyG index showed that these drugs do not contribute to the development of insulin resistance and do not provoke the development of calcification of the renal tubules or stenosis of blood vessels. There is also a better absorption of nutrients entering the body and a more intensive formation of new cells of a growing body, which is indicated by the concentration of cholesterol. Thus, the use of products containing natural biologically active substances has a positive effect on the processes occurring in the growing body, which is reflected in the main biochemical indicators of protein and carbohydrate-lipid metabolism.

Keywords: biologically active substances, medicinal plants, amyloyodine, biochemical blood parameters.

Rezumat. Influența substanțelor biologic active naturale asupra principalilor parametri biochimici ai sângelui. În studiul efectului extractelor obținute din plante medicinale din familiile *Asteráceae (Compósitae)* și *Lamiaceae (Labiatae)* și al preparatului amiloyodine asupra principalilor parametri biochimici sanguini (proteine, albumină, globulină totală, raportul albumină/globulină, glucoză, trigliceride, colesterol, raportul dintre albumină și globulină într-o unitate de volum sanguin, indicele trigliceride-glucoză (TyG) și raportul dintre trigliceride și colesterol - Ty/Cs) s-a evidențiat că utilizarea acestor produse favorizează acumularea resurselor energetice și activarea metabolismului cu economisirea simultană a costurilor energetice (în ciuda perioadei de creștere activă); creșterea hidrofilicității țesuturilor, datorită căreia transportul cationilor, anionilor, bilirubinei, sărurilor acizilor biliari, vitaminelor, unor acizi grași este mai intens; creșterea nivelului globulinelor, care favorizează o imunizare mai intensă (deci o recuperare mai rapidă) și intensificarea funcției de sinteză proteică a ficatului, ca urmare a căreia are loc o sinteză și un transfer mai rapid al hormonilor. Indicele TyG a arătat că acești agenți nu promovează rezistență la insulină și nu provoacă apariția calcifierii tubulare renale sau stenoza vaselor de sânge. Există, de asemenea, o mai bună asimilare a nutrienților și o formare mai intensă a celulelor noi ale organismului în creștere, după cum indică concentrația de colesterol. Astfel, utilizarea remediilor care conțin substanțe biologic active naturale are un efect pozitiv asupra proceselor care au loc în organismul în creștere, care este reflectat de principalii indicatori biochimici ai metabolismului proteic, glucidic și lipidic.

Cuvinte cheie: substanțe biologic active, plante medicinale, amiloidină, indici biochimici ai sângelui.

INTRODUCTION

The efficiency of specific feed energy consumption for the production of various types of livestock products can be built as follows: poultry meat> eggs> pork> milk> beef> lamb. Thus, poultry farming is the "locomotive" of the industry in the production of animal protein, the most important component of human nutrition (BUYAROV et al. 2022).

Statistics show that the production of poultry meat is ahead of the production of all other types of meat. The share of poultry meat in the total volume already in 2022 was 38.7% in the total meat procurement. In 2023, broiler meat production was 102.4 million tons, in 2024 103.3 million tons. According to the general forecast of the dynamics of world production and the joint report of the Organization for Economic Cooperation and Development (OECD) and FAO, by 2031 the consumption of poultry meat in the world will increase to 154 million tons, accounting for 47% of all meat, and by 2050 the production of poultry meat will increase by 122.5% (DMITRIEV et al. 2023; TSYNDRINA 2025).

To increase the level of productivity and prevent the development of pathologies, various means and biostimulants are used: vitamins, bacterial and pharmaceutical drugs, PMVK (protein-mineral-vitamin complex), Vitakorm-Reo, Primix-Forsil, NSAID (non-steroidal anti-inflammatory drugs), feed antibiotics, SD-1 (first stimulating drug - biostimulant), PV-1 (suspension that includes Dorogov's antiseptic-stimulator and a complex of vitamins), STEMB (stimulant tissue embryonic), Energosil (silicon-containing feed additive of a new generation) and many other means.

The use of natural growth stimulants, which are an alternative to feed antibiotics, is promising. Since the rejection of feed antibiotics to obtain environmentally friendly products is the most important element of modern technologies, specialists are increasingly using biologically active additives in feeding broiler chickens. In this regard, the use of prebiotics, probiotics, symbiotics, synbiotics, feed acidifiers, sorbents, phytobiotics, Algasol, preparations from marine products and medicinal plants (EGOROV et al., 2018), as well as complex preparations developed on their basis, is of great interest. In addition, natural plant extractives are fully utilized by living organisms, enhancing metabolic processes in cells, and are generally relatively low-cost.

With the purposeful and correct use of such biological compounds and biostimulants (Academician V.P. Filatov called "biogenic stimulators"), it is possible to carry out veterinary and zootechnical measures in accordance with the complex and physiological principles of veterinary medicine, to maximize the use of the biological reserves of the body, taking into account their physiological characteristics. As a result, due to the activation of metabolism, the digestibility and conversion of feed increases, the reproductive ability of animals and poultry increases, the general resistance of the body increases, cardiovascular diseases, ascites, hepatosis are prevented, the safety and egg production of chickens increases per initial layer, and productivity increases at the final stage of the production cycle.

However, when using such drugs, rarely any of the specialists seriously think about how this or that drug or complex of drugs affects the metabolic processes in the body; what happens to carbohydrate-lipid or mineral metabolism; whether the means used do not have any hidden or remote negative effect on the body or the composition of the intestinal microflora; And changes in the morphological and biochemical parameters of the blood of animals and birds grown using both existing and new means based on natural biologically active substances have not yet been sufficiently studied (BUYAROV et al., 2022).

Any external impact on the body, including the introduction of drugs and agents containing biologically active substances, to one degree or another affects the composition of blood, lymph and interstitial fluid. Moving through the blood and lymphatic vessels, blood and lymph ensure the homeostasis of the body, support humoral regulation, the course of metabolic and energy processes, transport oxygen, micro and macro elements, enzymes, hormones and all the necessary components for the normal functioning of organs, organ systems and the body as a whole to the cells of all organs and tissues.

It is for this reason that morphological and biochemical blood tests are very relevant, especially when making a diagnosis, choosing and selecting means of therapy, prevention and studying the effect of various drugs and means on the body. Also, the study of the morphological and biochemical composition of blood makes it possible to quickly and more effectively solve many problems and problems that arise in the conditions of modern technologies for keeping and breeding animals and poultry with a more economical, environmentally friendly (especially when using natural biologically active substances) and quick production of high-quality products.

In this regard, the goal was to study the effect of extracts (containing natural biologically active substances) made from medicinal plants of the *Asteráceae (Compósitae)* and *Lamiaceae (Labiatae)* and amyloyodine, containing iodine with amylodextrin (C6H10O5)n, on the main biochemical parameters of blood, in particular: protein, carbohydrate and lipid metabolism (protein, albumin, total globulin, albumin-toglobulin ratio, glucose, triglycerides, cholesterol, ratio of albumins to globulins per unit of blood volume, triglycerides-glucose index TyG and triglycerides-to-cholesterol ratio - Ty/Cs) in Adler silver chickens in postembryonic ontogenesis.

MATERIAL AND METHODS

According to the laboratory research methodology (research project number 220101: Scientific support for harnessing the resources of the animal veterinary sector, selection and adaptation of new breeds and hybrids, technologies and harmless curative methods, in conditions of climate resilience and consultations with specialists on the manufacture and storage of specific medicines, experiments were carried out to determine the effect extracts made from medicinal plants of the *Asteráceae (Compósitae)* and *Lamiaceae (Labiatae)* and amyloyodine containing iodine with amylodextrin $(C_6H_{10}O_5)n$ on some biochemical parameters of the blood of Adler silver chickens in postembryonic ontogenesis.

The object of the study was clinically healthy chickens of the Adler Silver breed at the age of 4-38 days in the amount of 60 heads, which were randomly divided into 2 groups, experimental and control, 30 individuals each without division by sex.

Chickens of the experimental group were daily, continuously, for 35 days, unlimitedly provided with a diluted decoction of medicinal plants instead of water (before use, 200 ml of decoction was diluted with 800 ml of tap drinking water). With the first morning portion of decoction of medicinal plants diluted with tap water (0.5-1.0 l), mixed and given 20 ml of the preparation containing iodine with amylodextrin (amyloyodine).

Chickens in the control group were not prescribed or given any drugs.

Blood sampling was carried out before the separation of chickens into groups on the 4th day and at the end of the experiment on the 35th day of rearing.

Blood for biochemical studies was taken before morning feeding.

Blood sampling from grown chickens was carried out from the underwing (axillary) vein. The bird was fixed in a lateral or dorsal position, the wing was straightened from the inside. They were squeezed coveredly above the elbow joint. The underwing vein protruded clearly in the middle of the elbow joint. The skin and vein were incised with a scalpel and the required amount of blood was collected in plastic Eppendorf tubes.

Determination of biochemical blood parameters was carried out on an automatic biochemical analyzer Stat Fax 3300 using special kits.

During biochemical studies, the following was determined:

- total protein qantitativ metod Biuret, End point (in a unified way with a green light filter of 540-560 nm), using the standard set of reagents TOTAL PROTEIN PLUS;

- albumin – colorometric determination of albumin using bromocresol green, guantitativ metod BROMCRESOL GREEN bcg – End Point using the standard set of reagents ELITech Clinical Systems ALBUMIN, wavelength 620 nm;
- glucose – by colorimetric method, using a standard set of reagents GLUCOSE PAP SL, wavelength 500±20nm;
- triglycerides - by enzymatic colorimetric method using a standard set of reagents TRIGLYCERIDES MONO SL NEW in vitro diagnostic, wavelength 500.052-570 nm;
- cholesterol – by enzymatic colorimetric method using CHOLISTEROL SL reagents with a 505nm filter.

The determination of the triglycerides-glucose TyG index was determined by a simple formula [triglycerides (mg/dL) × fasting glucose (mg/dL) : 2].

The ratio of triglycerides to cholesterol - Ty/Cs - was also taken into account.

Chickens of both groups were kept in the same conditions and on the same diet. Feeding of poultry was carried out with complete feed Combifuraj SCHN PKb 5k with the addition of Starter MV 1050 premix, fish meal and calcium according to age.

RESULTS AND DISCUSSIONS

As a result of the studies carried out, it was found that the main biochemical parameters in the blood serum of all experimental chickens were within the physiological norms, but some differences were observed by groups. Statistically processed research results were summarized in the tables below.

Proteins form the basis of body tissues (almost 20% of body weight) and perform vital functions. To assess the state of protein metabolism in the blood serum, the protein content, the concentration of albumins, globulins and the ratio of albumins to globulins were determined.

Table 1. The content of total protein and some protein fractions in the blood serum of chickens.

Index	**Group**	**Statistical indicator**			
		Before the experiment (age 4 days)		**After the experiment (age 38 days)**	
		M±m	Lim	M±m	Lim
Protein g/l	Experienced	24,15 ± 1,102	20,14-29,11	40,14 ± 0,938	38,40-44,80
	Control			37,86 ± 1,015	32,40-39,80
Albumin g/l	Experienced	9,90 ± 0,895	6,50-12,40	20,95 ± 0,773	18,16-23,15
	Control			20,61 ± 0,734	18,32-22,38
Globulin g/l	Experienced	14,25 ± 0,716	12,83-16,71	19,18 ± 0,817	17,37-21,65
	Control			17,19 ± 0,813	13,82-18,96
Albumin/globulin ratio	Experienced	0,68	-	1,092	-
	Control			1,198	-

Before the experiment, the level of protein in the blood serum in all experimental chickens was at the lower limit of physiological norms and amounted to 24.15±1.102 g/l (the norm of protein in the blood serum of chickens up to 5-7 days of age: 24-26 g/l), with the Lim distribution limit of 20.14-29.11 g/l.

In chickens older than 5-7 days of age and adult poultry, the protein content in the blood ranges from 32-47 g/l.

At the end of the experiment, the level of protein in the blood serum of chickens of both groups was also within the physiological norm.

In the experimental group, the protein concentration was 40.14±0.938 g/l (the limit of distribution was 38.4-44.8 g/l), which is 5.75% higher than in the control group, where the serum protein concentration was 37.86±1.015 g/l, and the limit of distribution was 32.40-39.80 g/l.

Thus, although the protein concentration in both groups is within the normal range, in the experimental group the protein level is slightly higher, and the concentration of protein and its fractions predetermines the growth energy of the bird at a certain stage of its development. Consequently, the energy resources in the body of chickens of the experimental group are somewhat higher, in connection with which the metabolic processes are somewhat more intensive, since protein and its fractions in blood serum are a source of amino acids for the synthesis of proteins of organs and tissues (GARMAEV & NEKRASOVA, 2019; KONOPATOV & VASILIEVA, 2021; DMITRIEV et al., 2023).

More than 50% of all proteins in the blood (up to 60%) are albumins, which not only transport various substances, control the process of water absorption, are responsible for the colloidal osmotic pressure of the blood, not allowing water to pass into the tissues excessively (this prevents edema). Due to this feature of albumins, the balance of water and electrolytes between plasma and tissues is regulated, the process of formation and accumulation of interstitial fluid, urea and lymph is regulated, and the necessary volume of blood for its normal circulation is preserved.

At the beginning of the experiment, the albumin content in the blood serum of chickens was 9.9±0.895203 g/l, which is almost equal to the norm (45% of total protein), the limit of distribution ranged from 6.5 to 12.4 g/l.

By the end of the experiment, the albumin content in chickens in both groups was also within the physiological norms. In the experimental group, albumin levels were 20.95±0.773 g/L, with a Lim of 18.16-23.15. In the blood serum of chickens of the control group, the albumin concentration was 20.61±0.734 g/l, and Lim was 18.32-22.38.

The increase in serum albumin in chickens of all groups can be explained by the use of high-protein feeds and active proteosynthesis in the liver.

In general, the content of albumin in the bird's blood serum in both groups is within the normal range, but in the experimental group the albumin level is 1.64% higher than in the control group. This indicates a better hydrophilicity of tissues. From this we can conclude that the chickens of the experimental group have a more intensive transportation of cations and anions, bilirubin, bile salts, vitamins and hormones, some fatty acids, which in case of disease can also contribute to a faster recovery.

As for globulins, at the beginning of the experiment, its level in the blood serum of chickens was 14.25±0.716 g/l, and Lim was 12.83-16.71 g/l. The concentration of globulins in the experimental group with a Lim of 17.37-21.65 g/L was 19.18±0.817 g/L, which is 11.55% higher than in the control group, where the albumin concentration was 17.19±0.813 g/L with a Lim of 13.82-18.96 g/L.

Globulins make up about 35-50% of all proteins in blood proteins. A high level of globulin, in the absence of a disease or other pathology in the body, indicates a high activity of the immune system, determines the speed of blood clotting. Thus, the large increase in the level of globulins in both groups can be explained by the fact that during the period of intensive growth and development of the body, there is also an intensive process of immunization, as a result of which the blood serum is enriched with globulins (KANEKO, 2008; KONOPATOV & VASILIEVA, 2021; BUYAROV et al., 2022).

Also, an increase in globulin levels during growth indicates good protein-synthesizing work of the liver, where sex hormone binding globulin (SHBG) promotes faster transport of hormones (testosterone, dihydrotestosterone (DHT) and estradiol (estrogen)) into the blood in a metabolically inactive form. Thus, it can be seen that more intensive processes of growth and development of the organism were in the chickens of the experimental group, where the level of globulins increased by 34.577%, while in the control group the level of globulins increased only by 21.877%.

The indicator of the state of protein metabolism of the body is expressed by the ratio of the number of albumins to the number of globulins per unit of blood volume. Regarding the albumin-to-globulin (A/G) ratio, it should be noted that the normal A/G ratio is always greater than 1, and ranges from 1.1 to 2.5, although this may vary depending on the laboratory and the age of the bird.

At the beginning of the experiment, the A/G was below normal and amounted to 0.68, which is often typical for newly hatched chicks that have undergone long-term transportation without food and water. At the end of the experiment, the this index increased in both groups and the A/G ratio in the experimental group was 1.092, and in the control group 1.198. Such dynamics of an increase in the A/G ratio indicates good growth and development of the body of growing young birds.

Table 2. The main indicators of carbohydrate-lipid metabolism in chickens.

Index	**Group**	**Statistical indicator**			
		Before the experiment (age 4 days)		**After the experiment (age 38 days)**	
		M±m	Lim	M±m	Lim
Glucose mmol/l	Experienced	8,88±0,800	6,31-9,64	12,84±0,827	9,6-14,8
	Control			11,40±0,937	8,6-14,8
Triglycerides mmol/L	Experienced	1,15±0,492	0,64-2,39	1,07±0,198	0,96-1,23
	Control			0,95±0,309	0,96-1,24
Cholesterol mmol/L	Experienced	3,76±0,435	2,84-4,31	3,96±0,260	3,64-4,16
	Control			3,62±0,342	3,14-4-11

Glucose is a simple carbohydrate that is needed by the body's cells to produce energy (KANEKO, 2008; KONOPATOV & VASILIEVA, 2021). Throughout the experiment, the concentration of glucose in the blood serum of chickens was within the physiological norms.

At the beginning of the experiment, the glucose level, with a Lim distribution limit of 6.31-9.64 mmol/L, was 8.88±0.800 mmol/L, which is within the normal range of 7.14-9.96 mmol/L for chicks under 7 days of age (Table 2).

At the end of the experiment, the concentration of glucose in the blood serum of chickens of both groups increased and was within the limits of the norms typical for young animals over 7 days of age and adult poultry: 9.3-16.5 mmol/L. In chickens of the experimental group, the glucose content increased by 44.59% (1.445 times) and amounted to 12.84±0.827 mmol/L at Lim 9.6-14.8. In the control group, the glucose concentration at Lim 8.6-14.8 increased by 28.468% (1.284 times) and amounted to 11.40±0.937 mmol/l, which is 11.152% (1.125 times) less than in the experimental group.

An increase in the glucose content indicates a lower utilization of glucose in the liver to provide the body with energy in animals of both groups, which is an indicator of a good accumulation of energy resources, despite the period of active growth. It should be noted that although the glucose concentration increased in both groups, in the experimental group it was slightly higher than in the control group, which should also have a beneficial effect on the upcoming period of egg-laying and spermatogenesis.

Glucose, once in the body, is either immediately utilized for energy, or stored in the liver in the form of glycogen, and the excess glucose, through lipogenesis, is quickly transformed into triglycerides and stored in this form in adipose tissue. In the process of triglyceride synthesis, about 15% of the potential energy contained in glucose is utilized, and the remaining 85% is converted into energy of stored triglycerides, which are one of the main markers of lipid metabolism (EGOROV et al., 2018).

It can be seen that at the beginning of the experiment the concentration of triglycerides slightly exceeded the upper limits of the norm of 0.3-0.9 mmol/l and amounted to 1.158±0.492 mmol/l, with a Lim of 0.64-2.39 (Table 2). This is most likely explained by the fact that the body of chickens in the first days of life freely and unlimitedly receives an excessive amount of lipids from the remains of the yolk sac.

At the end of the experiment, the level of triglycerides was restored to physiological norms. In the blood serum of chickens of the experimental group, the content of triglycerides at Lim 0.96-1.23 was 1.07±0.198 mmol/L. In the blood serum of chickens of the control group, the concentration of triglycerides at Lim 0.96-1.24 was 0.95±0.309 mmol/L, which is 11.007% less than in the experimental group.

The higher level of triglycerides in the experimental group in this case can only be explained by the fact that triglycerides were not only supplied with feed, but were also more actively synthesized in the liver from carbohydrates, in particular from glucose of endogenous and exogenous origin. Namely, in the experimental group, the glucose level was slightly higher, in the control group, which confirms better absorption of nutrients entering the body and more active feed intake by the chickens of the experimental group.

Table 3. TyG and Ty/Cs exchange indicators in chickens.

Index	**Group**	**Before the start of the experiment (age 4 days)**	**After Experience ends (age 38 days)**
TyG Index	Experienced	4,85	5
	Control		4,88
Triglyceride : Cs ratio	Experienced	1,15: 3,76 (0,307)	1,07: 3,962 (0,290)
	Control		0,95: 3,622 (0,263)

Also, when calculating the TyG index of triglycerides-glucose (see Table 3) (the first mention of this laboratory indicator has been known since 2018 [triglycerides (mg/dL) × fasting glucose (mg/dL):2]), it was found that at the beginning of the experiment this indicator was 4.85 mg/dL. At the end of the experiment, this parameter was 5 in the experimental group and 4.88 in the control group.

Such a ratio of triglycerides and glucose (TyG) allows us to assert that the drugs we use do not contribute to the development of insulin resistance and do not provoke the development of calcification of the renal tubules or stenosis of blood vessels.

In addition to triglycerides, one of the main indicators of lipid (fat) metabolism is cholesterol. Up to 80% of cholesterol is synthesized simultaneously with triglycerides in the liver. Cholesterol is necessary for the body to synthesize hormones (adrenocorticotropic, estrogens, progesterone, testosterone), nerve fibers, and create cell membranes. Cholesterol is present in large quantities in the organelles of almost all cells.

Also, even in greater quantities than for the formation of cell membranes, cholesterol is critically necessary for the synthesis of cholic acid in the liver. More than 80% of cholesterol is converted to cholic acid and then bile salts are formed, which ensure the digestion and absorption of fats (KONOPATOV & VASILIEVA, 2021).

The level of cholesterol in the blood serum of chickens at the beginning of the experiment at Lim 2.84-4.31 was 3.76±0.435 mmol/L. At the end of the experiment, despite the active growth of chickens, the cholesterol level was also within the physiological norm: 3.4-4.6 mmol/L, in chickens of both groups (Table 2).

At the same time, it should be noted that the cholesterol content in the experimental group increased by 1.053 times or by 5.098% and amounted to 3.96±0.260 mmol/l at Lim 3.64-4.16. In the control group, the cholesterol content decreased by 1.038 times or 3.670% and amounted to 3.62±0.342 mmlol/l at Lim 3.14-4-11.

A higher level of cholesterol in the blood serum of poultry of the experimental group indicates better absorption of nutrients entering the body and intensive formation of new cells of the growing body.

Also, when determining the lipoid profile - the ratio of triglycerides to cholesterol (the ratio "triglycerides/cholesterol" should be as close as possible to 1:1, and the ratio of 2:1 is the limit of normal) - it was found that at the beginning of the experiment this parameter was 1.158:3.76 (0.307) (Table 3). At the end of the experiment, the ratio of triglycerides to cholesterol in the experimental group was 1.07:3.962 (0.290), and in the control group: 0.95:3.622 (0.263)

Such dynamics can be explained by the fact that the body of the chickens of the experimental group first of all intensively utilized exogenous, and not endogenous cholesterol.

Analysis of the data obtained indicates that in the experimental group, all processes in the body of chickens during their rearing proceeded somewhat more actively and with less energy consumption.

We believe that the chickens of the experimental group had a more active metabolism with simultaneous energy savings due to the use of medicinal plants from the families *Asteraceae* (*Asteraceae*) and *Lacaceae* (*Lamiaceae*) and a preparation containing iodine with amylodextrin (amyloyodine). Thus, it can be seen that the natural biologically active substances proposed by us in the first weeks of postembryonic ontogenesis have a positive effect on the processes occurring in the growing body, which is reflected in the main biochemical indicators of protein and carbohydrate-lipid metabolism. Therefore, these products can be recommended for use.

CONCLUSIONS

The main indicators of protein and lipid-carbohydrate metabolism indicate that the medicinal plants from the families *Asteraceae* (*Asteraceae*) and *Clearworms* (*Lamiaceae*) and a preparation containing iodine with amylodextrin (amyloyodine) are used by us:

1) do not have a negative effect on the body;

2) allow you to increase metabolism.

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