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THE CONCEPT OF “ONE HEALTH” AND THE POTENTIAL USE OF NATURAL BIOLOGICALLY ACTIVE SUBSTANCES AND MICRONUTRIENTS - TAXIFOLIN, ARABINOGALACTAN AND MICROALGAE ARTHROSPIRA PLATENSIS IN ORGANIC LIVESTOCK PRODUCTION

Review

Abstract

The article presents the concept of "One health", approaches to its assessment, criteria for the formation and implementation of both national and international levels. The main directions in the implementation of the concept is the introduction of organic (ecological) agricultural production, monitoring of zoonoses and TRANS-limiting diseases of animals and humans. On the example of organic beekeeping requirements to its organization and technology are stated. The policy of the government of Russia and the main legislative acts in the field of production, marking, transportation, storage and processing of organic agriculture products are stated. The potential of using natural biologically active substances and biomass of microalgae Spirulina Platensis in the production of livestock and poultry products is revealed, Efficiency of their application in various ecological and technological conditions, influence on productivity, quality of production, a state of health and safety of a livestock is stated.

Key words: concept, health, diseases, environment, organic production, regulations. dihydroquercetin, arabinogalactan, microalgae, dairy cattle, pig poultry.

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КОНЦЕПЦИЯ “ОДНОГО ЗДОРОВЬЯ” И ПОТЕНЦИАЛЬНОЕ ИСПОЛЬЗОВАНИЕ ПРИРОДНЫХ БИОЛОГИЧЕСКИ АКТИВНЫХ ВЕЩЕСТВ И МИКРОЭЛЕМЕНТОВ-ТАКСИФОЛИНА, АРАБИНОГАЛАКТАНА И МИКРОВОДОРОСЛЕЙ ARTHROSPIRA PLATENSIS В ОРГАНИЧЕСКОМ ЖИВОТНОВОДСТВЕ

Обзор

Аннотация

В статье представлено понятие "Единое здоровье", подходы к его оценке, критерии формирования и реализации как на национальном, так и на международном уровнях. Основными направлениями в реализации Концепции являются внедрение органического (экологического) сельскохозяйственного производства, мониторинг зоонозов и транс-лимитирующих заболеваний животных и человека. На примере органического пчеловодства изложены требования к его организации и технологии. Изложены политика правительства России и основные законодательные акты в области производства, маркировки, транспортировки, хранения и переработки органической сельскохозяйственной продукции. Раскрыт потенциал использования природных биологически активных веществ и биомассы микроводорослей Spirulina Platensis в производстве продукции животноводства и птицеводства, показана эффективность их применения в различных эколого-технологических условиях, влияние на продуктивность, качество продукции, состояние здоровья и безопасность животноводства.

Ключевые слова: концепция, здоровье, болезни, окружающая среда, органическое производство,.дигидрокверцетин, арабиногалактан, микроводоросль, молочный скот, свиньи, птица.

The concept of "One health" comes from the old stereotype – "one medicine", formulated by veterinary epidemiologist K. Schwabe (1927-2006). According to his definition of this concept is necessary for unification of approaches in the struggle against zoonoses – diseases transmitted from animals to people and other cross-border diseases, thus representing a threat to the health of the population , and their means of existence , affecting livestock. Effective prevention of zoonoses requires cross-sectoral cooperation, including between the veterinary sector, the food safety sector and the public health sector. [1].

An important moment in the history of the concept of "One health" was the international conference held in New York on the theme "Building interdisciplinary bridges for health in a globalized world", organized in 2004 by the non-governmental organization for environment and wildlife conservation. The aim of the conference was to develop examinations of the health of humans and animals and the development of the "Manhattan Principles", which is essentially a list of recommendations and approaches which called for a global prevention, combat and control of epidemic diseases with the aim of supporting integration of the global ecosystem. In 2007, cooperation between Roger Mayer, President of the American Academy of veterinary medicine Association (AVMA) and Ronald Davis, President of the American medical Association (AMA), was the beginning in the context of the need to develop integrated approaches to human and animal health. Later, AVMA created an initiative temporary team of specialists, which prepared a report on the concept of "One health" and published it in 2010 [2]. A team of specialists, including representatives of AMA and APHA (American public health Association), established a Committee in 2009 to develop the scientific aspects of the concept of "One health". In 2008 , in the context of the crisis of avian and pandemic influenza, an international intergovernmental conference was held at which a common strategy was implemented to combat and control the crisis as well as infectious diseases circulating between animals, humans and ecosystems. The document was signed by the heads of the world organization for human and animal health - Food and agriculture organization, the world health organization, the world organization for animal health, as well as the UN Children's Fund, the world Bank and the joint national system for coordinating the fight against influenza. Borrowed the approaches of the American ABM in the definition of the concept of "One health" has been described as " collective efforts in multi-faceted work in the local and global aspects in achieving optimal health, animals and the environment [3]. In 2010, the leaders of these World organizations published a conceptual strategic work programme to strengthen international cooperation on health risk management. The importance of this document is related to the new reformation of the concept of "One health" by complementing the food sector as a critical element in this cooperation: "the World is able to prevent, detect, control , eliminate and be responsible for the risks to human and animal health associated with zoonoses and animal diseases that face food safety through multisectoral cooperation and strong partnership [3]. The introduction of the food safety dimension by international organizations updates the concept of "One health" and is a key point in the process by which the concept is manifested and expanded in response to food risks and represents a broader global transformation [4].

Recently, the world, including Russia, is actively developing ecological agriculture [5,6,7,8,9]. The global market for environmental products was estimated at us $ 25 billion per year in 2002. It is projected to reach a turnover of $ 200-250 billion per year by 2020. Most markets for environmental products, for example, in the EU or the USA, were formed as a result of the establishment and under the direct influence of the so-called Directives that define the necessary requirements for products, methods of its production and allow you to label it as "environmental" ("organic", "biological", "Bioorganic", "biophysical", "bio", "eco").

Under environmentally safe agricultural products understand such products, which during the adopted for its various types of "life cycle" (production –processing-consumption) corresponds to the established organoleptic, hygienic, technological and toxicological standards and does not have a negative impact on human health, animals and the environment. In Russia, a draft law on organic agriculture has been prepared, which for the first time recorded what can be called organic products. These are products obtained from healthy animals and plants, without the use of agrochemicals, pesticides, antibiotics, genetically modified (genetically engineered, transgenic) organisms, not subjected to treatment using ionizing radiation. Adopted GOST R " Organic production. Rules of production, storage, transportation [10].

The European Union has adopted a regulation on environmental production and labelling of environmental products, which, inter alia, states that:

- Ecological production forms an integrated management system of agricultural enterprises for food production, which combines best practices of ecological management, maintenance of a high level of species diversity, protection of natural resources, application of high standards in the protection of animals and a method of production that takes into account the fact that certain consumers prefer products produced using natural processes.

Ecological animal husbandry must meet high standards for animal protection. and also meet the requirements that take into account the specific needs of each particular species of animals. Maintaining the health of livestock should be based on disease prevention. Special attention in this regard should be given to the terms of the content, practice content and density of the population. In addition, the selection of animal breeds should take into account their ability to adapt to local conditions.

The system of ecological livestock production should strive to implement the production cycles of different species of animals using ecologically fed animals. Therefore, it should be supported to increase the gene pool of animals contained in the use of environmental methods, which improves the provision of animals through domestic production and thus helps the development of the sector [11].

Technical regulations of the CU "On safety of food additives, flavorings and technological AIDS" have also been adopted and entered into force in Russia [12]. This document defines a food additive that represents any substance (or mixture of substances) that has or does not have its own nutritional value, usually not consumed directly in food, intentionally used in the production of food products for technological purposes (function) to ensure the processes of production (manufacture), transportation (transportation) and storage, which leads or may lead to the fact that the substance or products of its transformations become components of food products. Food additive can perform several technological functions. An example of such feed and food additives can be dihydroquercetin and arabinogalactan, derived from larch Daurian (Larix dahurica Turez)

and having a wide range of biological properties, the main of which are respectively antioxidant and prebiotic.[13]. Another source of micronutrients and biologically active substances for livestock, poultry and other sectors of agriculture and food processing industry is the microalgae spirulina (Arhtrospira Platensis) [14,15].

Safety of food agricultural products is evaluated according to the established TR CU 021/2011 - indicators and standards: microbiological standards –pathogenic, microbiological safety standards, hygienic safety requirements, permissible levels of radionuclides cesium-137 and strontium-90.[16].

Due to violations of the nutritional conditions and viability of plants and animals, the quality of products is reduced. Nutrition is one of the main functions of the body. The growth and development of plants largely depends on the conditions of nutrition and habitat, the Violation of root nutrition associated with soil erosion, salinization and waterlogging is accompanied by a decrease in crop yields and a deterioration in the quality of crop production. It is established that the grain of wheat grown in eroded fields, reduced protein, starch, gluten, trace elements. Food quality of grain deteriorates.

Significantly deteriorates the quality of crop products with pollution of plant habitats. Most often, the environment is polluted by industrial waste , pesticides used in agriculture. Effluents of livestock farms and complexes. Pollution of the environment can cause the accumulation in plant tissues of a large number of salts of nitric (and nitric) acid, residues of pesticides, heavy metals, radionuclides. Under the influence of pollutants and xenobiotics, the quality of plant food raw materials and food products is reduced. Plant food to become tainted. Often harmful and even toxic and pathogenic (pathogenic to humans).

The toxicants contained in the phytomass, arrive in subsequent Evenia the food chain. They appear in an organism of heterotrophs, including in a body of farm animals. Distribution of elements –toxicants in the animal organism, as a rule, is uneven. It depends on the physico-chemical properties of pollutants and other factors. Thus, DDT is concentrated mainly in adipose tissue, lead in the liver and kidneys, cadmium – in the kidneys, radioactive iodine – in the thyroid gland, strontium – in the bones. Many chemical compounds that migrate through the food chain are transformed into new forms. Some of them are neutralized, others, on the contrary, become more harmful. The concentration of persistent chemicals and long-lived radionuclides increases in the final links of the food chain, including in the human body. Under the influence of pollutants and xenobiotics contained in the body of animals, the quality of animal products is reduced food raw materials and foods of animal origin often become substandard or even harmful, pathogenic.

The functioning of the biogeochemical food chain and the quality of crop products and livestock, a certain influence is rendered by climatic (microclimatic), hydrological, biocenotic, anthropogenic factors and also by adverse weather and climatic environment during droughts, torrential rains and floods. In case of mass diseases of plants and animals, in the period of andropogenic ecological catastrophes, the conditions for the development of crop and livestock production can deteriorate dramatically. This leads to a decrease in the production of agricultural products of plant and animal origin and deterioration of its quality.

To obtain environmentally safe products, it is necessary to have reliable baseline data on the ecological and Toxicological situation in agroecosystems, especially those experiencing the stress of long-term intensive use of agrochemicals (fertilizers, pesticides, meliorants, etc.).

In recent decades, as noted by the world health organization, growing threat is posed by the problem of microbial resistance arising unjustified use of antibiotics in medicine and animal husbandry. Scientists in the US, the UK and China call on UN to convene a session to discuss the issue and action to combat "supermicrobs", sharply reduce the use of antibiotics in medicine and farming. Otherwise by 2050 the 10 million people a year will die from infections that cause antibiotic-resistant bacteria.

The work should begin with an assessment of the ecological and Toxicological state of the agroecosystem, first of all - the soil cover. The desire to increase the productivity of cultivated crops and farmed animals without proper consideration of environmental requirements leads to an unjustified increase in the use of mineral fertilizers (mainly nitrogen), pesticides and meliorants. Emissions of industrial production and transport, municipal waste supply to natural and artificial ecosystems compounds of polychlorinated biphenyls, sulfur, heavy metals, etc. Among natural pollutants, aflo – and other mycotoxins are isolated.

The problem of obtaining high-quality food in conditions of negative anthropogenic impact on the environment, including in the process of agricultural production, can be solved on the basis of greening the existing or newly created agricultural systems. Pollution of crop and livestock products by various harmful substances is caused by a variety of interrelated processes with different intensity in the associated environments and components of ecosystems. At the same time, in many regions, not only the direct action of chemicals increases, but also the manifestation of these effects becomes more complicated. In this regard, an important element of environmental production is the assessment of the ecosystem. The ecosystem is a functional unity of living organisms and their habitat. (Figure 1)

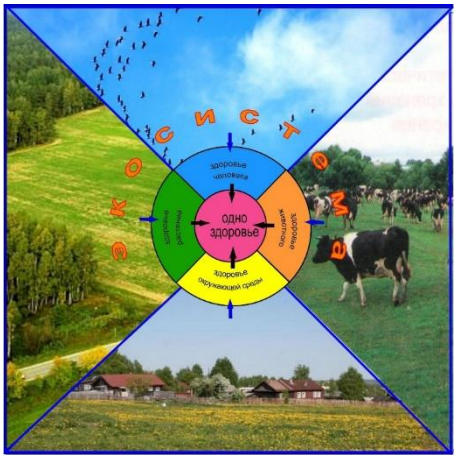

Figure 1 – Ecosystem in the concept of «One health»

Key features of the ecosystem – its dimensionless and strangulate. With the aim of providing food of the people artificially creates agroecosystems. They differ from natural low stability and stability, but higher productivity. The main tasks of ecological and Toxicological assessment of agroecosystems are as follows:

- identification and comprehensive characterization of sources of environmental pollution ; - monitoring of pollutants through all possible channels of their migration, delineation of zones of probable impact on living organisms; identification of sites for the deposition of pollutants;

- biogeochemical assessment of migration and concentration of pollutants both directly in the pollution zones and during their transfer along the trophic chains;

- determination of the dynamics of environmental pollution, the rate and volume of receipt, distribution and removal of the studied compounds; obtaining forecast materials.

Thus, the concept of "One health", formulated in the last century in connection with the need to combat zoonoses and transboundary diseases existing between animals and humans, has evolved under the influence of globalization of food production and markets. migration processes of the population of the planet, the widespread use of synthetic chemicals, genetic engineering and other means and methods that have increased the risks of public health. As a result, in many countries of the world began to develop alternative, organic agriculture, based on natural production processes as an integral part of this concept .

At the same time in the world, including Russia, actively developing ecological agriculture. According to forecasts by 2020 the global market for ecological (organic) products can achieve a turnover of 200-250 billion dollars a year.

Under environmentally friendly agricultural products understand the products that are within the adopted for the various types of life-cycle (production –processing-consumption) complies organoleptic, hygienic, technological and toxicological regulations and no negative impact on human health, animals and the environment. In Russia prepared a draft law on organic agriculture, for the first time recorded, what can be called organic products. This product is obtained from healthy animals and plants, without the use of agrochemicals, pesticides, antibiotics, genetically modified organisms that have not been subjected to treatment with ionizing radiation. Adopted GOST R 56508-2015 "Organic Products. The rules of production, storage, transportation" with the introduction of 01.01.2017. In this regard, there is a need of search for new natural bioregulators of organisms that provides high resistance of animals to the effects of biotic and abiotic environmental factor, safety, high reproductive ability and the realization of the productive potential of the animal.

These properties are natural substances – bioflavonoids – this is a diverse group of plant polyphenolic compounds, the structure of which is diphenylpropanoic carbon skeleton. In plants found to contain more than 4,000 flavonoids identified chemical structure. Bioflavonoids can be used for the synthesis of biologically important compounds in the cell (e.g., ubiquinone).Rutin and quercetin – polyphenols with P-vitamin activity, are effective antioxidants. Flavonoids (catechins) of green tea can exert pronounced cytoprotective effect, which is based on their ability to neutralize free radicals. Unlike vitamin E, bioflavonoids in addition to direct anti-radical action may also bind metal ions with variable valence, inhibiting, thus, the process of lipid peroxidation of membranes.

Damage to the structural integrity of cells (biomembranes) causes excessive activation of free radical oxidation and the formation of its toxic products, which ultimately leads to loss of productivity and natural resistance in animals and in certain conditions becomes a primary or secondary pathogenetic link of the disease.

One of the most studied flavonoids is dihydroquercetin with a wide range of biological properties; regulates metabolic processes, has a positive effect on the functional state of internal organs of the body, creates mechanisms to protect healthy cells from pathologies caused by chemical poisoning, exposure to electromagnetic radiation and radiation by neutralizing radical activity, processes of viral and bacterial nature. It is non-toxic, harmless, has a high activity at low concentrations, resistant to thermal and mechanical stress. Recognized as the standard antioxidant and is widely used in medicine and food industry.

Dihydroquercetin is currently used in more than 100 biologically active food supplements and medicines, as well as in food and cosmetic products that are susceptible to oxidation.

Dihydroquercetin is also necessary for animals, especially when breeding and production of livestock in anthropogenic heavy metals (Pb, Cd, As, Hg, etc.) and radionuclides (90Sr, 137Cs), the territories, and is also vulnerable to pollution, industrial chemical, metallurgical, petrochemical and other industries.

Introduction in the diet of farm animals and poultry "Ecostimul-2" has a positive effect in immunodeficient condition, broncho-pulmonary pathology and the violation of the functional state of the liver, etc., which is usually the result of exposure to the adverse factors of environment and technology, inadequate physiology of farm animals.

Thanks to the activity and antioxidant properties of dihydroquercetin significantly improved metabolism on the border of the cell and the capillary and increasing the antioxidant status of the organism. Antioxidant action of dihydroquercetin, like other flavonoids, is one of nonspecific mechanisms of realization of many other biological properties.

Currently, conducted extensive research on the effectiveness of dihydroquercetin in dairy cattle breeding, pig breeding, poultry farming, beekeeping, rabbit breeding and fur farming. Efficiency of its application in the areas contaminated by radionuclides and heavy metals in dairy cows and calves was shown to increase the excretion xenobiotics, resistance and productivity of animals. The positive influence of dihydroquercetin on the animal organism as manifested in the period of unfavorable environmental factors, and in the period of technological factors.

The unique properties of dihydroquercetin allows to use it extensively in the food industry to:

- increase periods of storage of raw materials for the production of food products themselves and foods containing fats;
- make food products for therapeutic and prophylactic qualities;
- increase shelf life of fats and vegetable oils;
- increase the shelf life of milk powder, condensed milk and other milk products, in particular cream, ice cream, sour cream, yogurt, and also prevents vegetables, fruit and products of their processing from darkening and premature decay.

The use of dihydroquercetin in fat-containing foods prolongs their shelf life several times and gives them a pronounced relaxation properties, the consumption of such products gently increases the activity of the immune system a natural and physiological way.

Dihydroquercetin is introduced into the composition of food products is especially necessary for people living in ecologically disadvantaged areas. Regular consumption of foods with dihydroquercetin protected the liver from damage by viruses and various toxic substances, toxins, radionuclides and salts of heavy metals naturally. Currently being developed by GOST 33504-2015, Dihydroquercetin,TU., which is introduced from 01.01.2017 .

Research on the use of drugs on the basis of dihydroquercetin conducted in the farms of the Bryansk, Tula and Yaroslavl regions contaminated by radionuclides after the Chernobyl accident, heavy metals, oxides and other xenobiotics as a result of emissions of the metallurgical, petrochemical and paint industry, and relatively environmentally safe Moscow region.

• The use of "Ekostimul 1" in the diet of cows by breeding them in Novozybkov district of the Bryansk region contaminated by radionuclides allowed to increase nonspecific resistance of the organism to reduce the content of 137Cs in milk in 1,45 times, and increase average daily milk yield of 2.5 liters with a simultaneous increase in the content of fat in milk, which allowed us to obtain regulatory in environmental safety of milk and net income from the sale of the additional milk yield in the amount of 130,9% relative to control cows.

• On the farm of the Tula agricultural research Institute, located in Plavs'ke area contaminated with radionuclides and heavy metals used in feeding cows " Ekostimul -1" allowed to reduce the 137Cs content in milk from 2.81 Bq/kg to the level of the minimum detektorami activity and the lead content of milk of cows and to normalize carbohydrate and fat metabolism in the body (patent RU 2328132 S2).

• Inclusion in the diet of highly productive cows " - Ekostimul -1" on the farm "Dubrovitsy" Moscow regeon allowed to increase the average daily milk yield from 31.4 kg to 34.7 kg, or 10.6%, to get additional profit of 792 rubles. per cow per month, normalize carbohydrate and fat metabolism.

FA «Ekokor» designed for use in periparturient period for prophylaxis and correction of disorders of carbohydrate and lipid metabolism, clinical, subclinical acidosis and ketosis, disorders of function and fatty degeneration of the liver; stress and free radical oxidation of lipids, disorders of cardiovascular system and microcirculation in the central nervous system, the glands, including the breast, and tissues of the body; and increasing antioxidant protection of the organism; reproductive ability, milk productivity and period productive use of cows (patent RU 2454228 S2).

As a result of prophylaxis and correction of above violations and pathologies in the organism of cows in the periparturiend period when the Ekokor was given at cow have more fully implemented the genetically determined productivity potential and improve the productive health that is expressed in receiving additional 500-700 kg of milk of natural fat in 305 days of lactation, which ultimately contributes to the branch profitability by 25-30%.

• Application of "Ekostimul 1" for growing calves suckling period in conditions of contamination of environment by radionuclides and heavy metals has reduced the degree of resorption from the intestine of radionuclides 90Sr, 137Cs, Pb and Cd in 2, of 1.9, 1.5 and 200 times, respectively, resulted in calves that received feed additive, increased the level of resistance that contributed to the average increase for 6 months for 838 g, which was higher than in the control at 3%.

• Experience on calves held in JSC "Krasnaya Poyma", located in Moscow region, when watering of milk acidified with formic acid with the addition of " Ekostimul -2" increased calf vitality and enabled to obtain the average daily gain over the first 50 days of 864 g and a subsequent 50 days to 1113 g, which was more than in control 13.1 and 10.5% respectively.

The economic efficiency of growing calves when applying Ekostimul -2 702,2 amounted to RUB on the head or 11.9 RUB. on 1 RUB. of the cost of a feed additive.

• In the studies carried out on the farm "Dubrovitsy" in Moscow region and the use of probiotics in Tokarina and Carolinavacation together with Ecostimul-2, with nursing it is impossible calves acidified with formic acid of milk were received daily gain 817 g, which was greater than the control at 100 g and more in the group of calves treated with probiotics at 26g. The result was obtained 2.3 and 1.7 roubles of profit per 1 ruble of the costs.

• The use of food additives Ecostimul-1 and Ecostimul-2 when growing suckling piglets and weaners was also cost-effective. Using Ecostimul 1 separately and in conjunction with probiotics Tokarina and amilovarina contributed to the reduction of disorders of the gastrointestinal tract 2.5 times at 100% of safety stock, as well as increasing the average daily gain of 21.3 and

15.9%, respectively, when joint with probiotics and individual application of Ecostimul-1. The economic effect from the use of this composition was 16.5 and 13.8%, respectively relative to the control.

• When growing pigs after weaning at 60 days of age on the same farm Ecostimul -1 was also effective. With 100% preservation of average daily gain reached 540 g, which was higher than in the control by 21.8%.

• In other studies on piglets weaned within 52 days, on the full grown animal feed SK-4 and SK-5 with the addition of - Ecostimul 2" separately and together with arabinogalactan, the average increase amounted to 496 and 504 g, respectively, at 100% of safety, which was higher than in the control by 20.6 and 22.6% respectively at 90% intact.

A particularly high efficiency of Ecostimul 2 and arabinogalactan appeared in the period of extreme environmental heat – July-August 2010, when the pig farm was the temperature during this time at +30°C, and the air was present "smog". During this period, average daily gain when giving Kostial-2 and arabinogalactan was 618 and 570 g when fully intact, which was higher than in the control group, 38.8 and 28.1% respectively, and in 70% of safety stock.

When using FA Ecostimul 1 and 2 and arabinogalactan during a full cycle of growing and fattening the live weight of 100 kg pigs was achieved at 193 and 203 days, which was lower by 53 and 43 days, compared to the control. With all indicators of the quality of carcasses and pork were significantly superior to control. The result is economic efficiency in the use of FA Ecostimul 2 and arabinogalactan amounted to 817 1799 and RUB on the head for the period of growing and fattening.

• Studies on the use of " Ecostimul-2" on the chickens-broilers was carried out on experimental base of Orenburg SAU.

During the 42-day growing period the average daily live weight gain was gradually increased, reaching a six-week age of 53.86 g, in the group of chickens treated with " Ecostimul 2" and 49,75 g in the control group. The result is the live weight of the broiler at the end of cultivation amounted to 2208 g with 93% intact when included in the diet " Ecostimul -2", which was more by 8.27% compared to the control group at 85% intact.

The use of FA Ecostimul -2 and arabinogalactan in the cultivation and industrial use of laying hens was also positive.

Analysis of productivity of laying hens showed that the average egg weight in the group receiving Ecostimul 2, exceeded the control values by 2.71%, in addition, it increases the egg production of birds of the experimental group by 1.37%. Along with this increase the cost of feed for 1 hen for the entire experimental period by 0.72%.

Distribution of eggs by categories shows that the bird experimental group more intensively increases productivity with age. As early as 26 weeks of age, the proportion of eggs of I category is more than 58% of the total weight, whereas in the control group of this level reached only by the age of 28 weeks.

Between 25 - to 43-week-old birds from the experimental group received from 8,92 to 9.64% of eggs with an average weight of 75 g, while in the control group eggs of the highest category by weight was only in the period from 23 to 29 weeks of age and not more than 3.03 percent of the total number of eggs.

High efficiency of application " Ecostimul -2" was obtained in beekeeping. Bee families was provided in drinking bowls water solution Ecostimul -2 at a concentration of 5 mg/l in early spring exposure hives after wintering for two months before the main honey flow, stimulated oviposition by the Queen, which was made in the experimental group 1429 eggs a day, which was more than in control of 16.0%. With the fecundity of females is positively correlated honeyproduktivnost bee colonies.

The food industry digidrokwertitin used in two ways:

As an antioxidant, which allows to increase the shelf life of the product. The use of digidrokvertsetina in the dairy industry due to the fact that it prevents the process of oxidaition food and increases the duration of their shelf life in 1.5 - 4 times, retains the original organoleptic characteristics for a longer time. For example, the shelf life of the yogurt increases to 60 days, the mayonnaise for up to 30 days, ice cream 2-3 times sour up to 40 days of cheese melted to 120 days, products. made of dried milk with fat content of 25% by 1.5 – 2 times,milk powder, , soy - milk concentrate – up to 12 months, cottage cheese freeze dried – 2 times.

Dihydroquercetin contributes to the inhibition of the process of the growth of microorganisms in the finished product. In particular, has an inhibitory effect on Staphylococcus aureus (S. aureus), 90 %; lipolytic microorganisms from 44 to 88%; bacteria L. monolcytogenes 30 %, E. coli 12 %. ; inhibits wild yeast of the genus Rhodotorula, lactic acid bacteria and bacteria of the group Aicyclobacillus acidoterrestris .

At present time Commition implemented decision (EU) 2017/2079 of 10 November 2017 the authorizing the plaicing on the market of taxifolin-rich extract as a novel food ingredient under Regulation (EC) №258/97 of the European Parlament of the Council (noptified-under-document C (2017) 7218)

(Official journal of European Union L*295/81/)

Currently, the production of livestock products is based on highly productive genotypes of animals and birds, which unfortunately. very sensitive to the environment and production technologies. As a result, there is a wide spread of diseases caused by stress, metabolic disorders, immune disorders, reduced reproductive function, which leads to premature elimination of uterine and reduce the quality of production of productive livestock. Antibiotics are widely used in the prevention and treatment of these diseases. Today, antibiotics are used in the treatment of poultry, bees, to increase the growth of young cattle and pigs. In the world there are more and more new drugs. Pathogenic microorganisms can mutate and each time it is necessary to introduce new antibiotics. They remain in production -in meat, egg, milk, and at consumption of such production at people, especially at children, various allergies are shown and susceptibility, in case of a disease, to medical antibiotics decreases.

In recent decades, as noted by the world health organization, growing threat is posed by the problem of microbial resistance arising unjustified use of antibiotics in medicine and animal husbandry. Scientists in the US, the UK and China call on UN to convene a session to discuss the issue and action to combat "supermicrobs", sharply reduce the use of antibiotics in medicine and farming. Otherwise by 2050 the 10 million people a year will die from infections that cause antibiotic-resistant bacteria.

Biological and pharmacological properties of microalgae spirulina (Spirulina platensis) Spirulina (Spirulina platensis) is a unique product of nature. The peculiarity is that it is based on photosynthesis-the process of direct absorption of the energy of sunlight, which is typical for plant life forms. At the same time, the biochemical composition of spirulina cells to some extent similar to the composition of animal cells. The combination of the properties of both plant and animal organisms in microalgae

cells is another factor determining the high biological value of spirulina. The biomass of spirulina contains absolutely all substances that are necessary for humans and animals for normal life. A number of special substances – bioprotectors, biocorrectors and biostimulators - are not found in any other product of natural origin. This causes a truly phenomenal properties of spirulina as a food product and therapeutic and prophylactic agent of a wide range of actions. Blue-green algae of which spirulina has a cell wall consisting of monopoliser muraina, easily digestible by the digestive juices of man and animals, in contrast to unicellular green algae Chlorella that has cellulose casing, which can only destroy the microflora of ruminants. The soft cell wall makes it a more digestible product in the world. Studies have shown that spirulina is unmatched due to the high quality of plant protein, the highest digestibility of dietary elements, saturation with the most essential vitamins and minerals.

Spirulina has a wide range of biological activity: stimulates metabolism, strengthens the bones, normalizes the condition of the skin and hair and mucous membranes, neutralizes toxins, improves the function of the digestive system. Polyacids in spirulina have a positive effect on the reproductive system and its function. Contributes to the normal pregnancy. Increases the quantitative and improves the qualitative composition of lactobacilli and bifidobacteria in the intestine. In lactating animals increases milk production. Removes from the body heavy metals, toxins, radionuclides. The ficocyanin contained in spirulina prevents cancer and immunodeficiency. The combined use of spirulina with drugs can neutralize their harmful effects. Reduces nephrotoxicity when exposed to heavy metal salts. Provides resistance to radiation exposure. It helps to maintain a high level of hemoglobin and red blood cells. The ratio between amino acids, vitamins and trace elements is optimal, physiologically balanced, which leads to the normalization of redox reactions in the body of the animal, so spirulina is a self-sufficient drug and eliminates the need for similar means (protein supplements, vitamin complexes, etc.). Due to the high quality content of proteins and vitamins reduces the need for feed. It has a General healing effect on the body due to gamma-linoleic acid. As a result, the productivity of animals and their resistance to various diseases increases.

Thus, having in its composition a full-fledged protein, carbohydrates, fats, macro-and microelements, vitamins, phycocyanin, beta-carotene, gamma-linoleic acid and other biologically active components that can each individually and all the more together to have a powerful positive effect on the human body and animals, contribute to the normalization of existing violations, if necessary, or increase the protective forces of the body a, its performance and resistance to adverse environmental factors.

The practical application of spirulina in the nutrition of farm animals and poultry was positive [17-25]. The diet of lactating cows was administered raw spirulina biomass at a dose of 7, 14 and 28 g/head/day. within 70 days. The highest increase in the average daily yield was obtained at a dosage of 14 g/head/day. and it was 5.35 kg, which was higher than in the control group by 25.8%. In the milk of cows of all experimental groups increased fat content by 0.22, 0.16 and 0.63%. compared to control. In another experiment cows were given a ration premix "Zoonotic" content of spirulina, 50 g/head/day. within 80 days. During this period, the average daily milk yield in cows of the control group decreased from 15.2 kg to 13.4, and in cows of the experimental group increased from 16.9 to 18.6 kg (by 15.1%). The increase in milk yield is due to the improvement of digestion in the rumen and the General condition of the cows [17].

Introduction to the diet of dairy cows 5 g/head/day of spirulina in the form of powder increased digestibility of feed nutrients: dry matter by 3.4%, protein by 7.7%. fat at 2.2% fiber at 2.2% and BEV at 3.1%. It also had a positive impact on productivity. Average daily milk yield in terms of basic fat content in cows receiving spirulina was higher by 8.75%. with a higher content of fat and protein. Produced from the milk of cows receiving spirulina, sweet butter, cheese and kefir were characterized by higher consumer properties In the oil there was a decrease in saturated fatty acids, and in the cheese an increase in the content of amino acids, mainly essential. Dairy products were also characterized by a higher content of caratinoids and vitamins [18].

In another work [19] cows of black-and-white breed at the age of 3-4 lactation for 60 days at 3-4 months after calving were given a diet of 20 g granules with a biomass of spirulina in the amount of 10%. As a result, cows receiving spirulina increased milk productivity by 14.4%.and fat and protein content. As a result, over 60 days of experience from cows received more 92.1 kg of milk, 4.43 kg of fat and 3.53 kg of protein. In the milk of cows of the experimental group at the end of the study, the content of somatic cells was lower by 47.3%, which indicates the effect of cyanobacteria on udder health. Spirulina has had a positive effect on the physiological and microbiological processes in the rumen, maintaining its state in the physiological norm. It was found the increase in the formation of volatile fatty acids by 32.95% in the beginning and 9.4% at the end of experiment, the increase in the number of ciliates by 37.7% at the beginning and by 11.29% at the end of the experience, as well as observed and uvelichenie number of Mafang 5.2% and lactobacilli by 6.9% in comparison with cows of the control group, which indicates the prebiotic properties of spirulina. Hematological analysis of blood showed that its parameters in cows of both groups were within the physiological norm, but by the end of the experiment in cows of the experimental group the number of red blood cells and hemoglobin was greater by 12.5 and 6.8%, respectively, than in the control group, which indicates the effect of spirulina on hematopoiesis.

The unique chemical composition of spirulina biomass is especially in demand when growing young animals. Studies on calves showed that the inclusion in the starter feed at a dose of 15 mg/kg of live weight of spirulina allowed to improve the digestibility and use of nutrients of the diet, which eventually increased the average daily increase. So, in the standard feed – starter replaced sunflower cake and peas rapeseed in the size of 10% and added spirulina. As a result, during the milk growing period, the increase in calves in the group with spirulina was 821 g against 760 g in the control. The digestibility of feed with spirulina was higher than in the control and amounted to 74.7% against 72.9%, respectively. In the blood of calves treated with spirulina, a higher carotene content of 0.525 mg/% was observed, compared with 0.39 mg/% in the control. The heifers receiving spirulina reached 388 kg of body weight at the age of 13 months and were inseminated while the control heifers were inseminated 1.5-2 months later [20].

The use of spirulina in pig nutrition has also been positive. In the experience of 6 sows, Landrace sired crossbred Duroc x pietrain boars in the diet was added granulated spirulina in an amount of 2 g of cyanobacterial mass with a moisture content of 75% with 82 days of gestation up to weaning at the age of 28 days. The analysis of the experience data showed that the live weight of one pig in sows of the experimental group was higher at birth by 19.8%, and at weaning by 16.6% with an average

daily growth of 211 g and safety of 93.4% against 182 g and 83.3%, respectively, in controls. Spirulina has had a positive effect on the chemical composition of milk and the digestibility of nutrients in the diet. In the milk of sows receiving spirulina, the content of fat, protein and lactose was higher by 0.33, 0.39 0.38%, respectively, than in sows of the control group. The digestibility of dry matter, protein, fat and fiber was also higher by 1.12, 3.63, 1.72 and 1.33%, respectively, than in sows of the control group. In the blood of experimental sows the concentration of erythrocytes and hemoglobin was higher by 14.5 and 5.33%, respectively [19].

In other studies on the use of spirulina in pig production were also positive [16,21,22,23].

The use of spirulina in poultry nutrition has also been effective. Thus, feeding chickens with a full-fledged compound feed enriched with spirulina in the amount of 300-400 g/t for two months increased the average daily growth of young animals to 37 g, egg production to 74.6%, the average egg weight to 66.2 g compared to 5.1 g, 69.9 % and 61.4 g, respectively, in the control group. In this case, the increase in the content of vitamin A in the yolk to 10.5 μg/g [http://poultry-new.narod.ru/spirulina html..16/03/2019].

In another study, the effectiveness of adding spirulina to feed when rearing young chickens was studied. The best results were obtained when it was included in the amount of 0.5 %, which increased the digestibility of protein, fat and BEV, respectively, by 1.4; 2.33 and 2.12%. At the same time, the use of nitrogen increased by 3.22%, calcium by 2.35% and phosphorus by 2.1%, which made it possible to grow young animals with a standard live weight while reducing the cost of growth by 2.37-6.92%. The application of spirulina in the amount of 0.5-2.0% for replacement of grass meal in animal feed contributed to the higher egg production by 2.17-3.48 per cent while reducing the cost of feed for products by 5.85-*.20%. At the same time, the digestibility of protein, fat and fiber increased in chickens by 4.21; 5.20 and 1.63%, respectively. The use of nitrogen improved by 3.3%, BEV by 4.23%, calcium by 4.9%, phosphorus by 3.2%, While there was an increase in serum protein, lipids, calcium and phosphorus. Replacement of grass meal in mixed feeds contributed to the improvement of egg quality, which resulted in an increase in the thickness of the shell by 5.29-8.24% and a decrease in elastic deformation by 2.63-6.56%. Differences with control in favor of chickens, receiving spirulina, the content of vitamins in the egg amounted to vitamin A 34.13-48.37%; vitamin E and B2 -2.87-7.62 and 3.58-10.92%, respectively. The improvement of the biological value of eggs contributed to the increase of their fertilization and excretion of chickens by 4.24-5.37% and 8.5-9.8%, respectively [24].

Pharmaco-experimental justification for application of spirulina Platensis in growing chickens was carried out at the cross Rodonit –"Lohmann brown" in terms of CJSC "Chebarkulskaya ptitsa". The use of spirulina in the diet of chickens for 105 days at a dose of 1.1 g /head/day from 15 to 90 days of age and 1.8 g/head/day from 90 to 120 days of age normalized the protein spectrum of blood serum by reducing the total protein content to physiological boundaries while reducing the concentration of albumins and increasing γ-globulins by 30.9%.; reduced glucose by 17.7% and pyruvic acid by 8.6%, increased the concentration of calcium and inorganic phosphorus in the blood by the end of the experiment by 75.03 and 39.82%, respectively, with an increase in the content of these elements in the bones, reduced the activity of schf to physiological norm and increased the activity of ALT and AST to 8.72 - 17.10, respectively, increased the content of carotene in blood serum by 2.5 times. The use of spirulina in the cultivation of chickens increased their safety by 0.26% and an increase in live weight by 13.06%; reduced the accumulation of zinc in meat by 1.6 times, lead and Nickel by 4.54 and 5.94%, respectively. Spirulina increased the biological and nutritional value of slaughter products by increasing the concentration of essential (tryptophan, isoleucine, threonine, methionine, leucine, phenylalanine, valine) in meat by 7.06 -57.30%, and interchangeable amino acids (serine, glutamic acid, glycine, alanine, Proline, arginine) by 4.08 - 48.65%. Also increased the content of iron, copper and manganese in meat by 10-84,14% and the content of vitamin A in the liver by 16% and vitamin B2 by 39.7% [25].

Conflict of Interest

None declared.

Конфликт интересов

Не указан.

References

1. Глобальная система раннего оповещения о серьезных болезнях животных, включая зоонозы (ГСРО). // Информационная записка ИНФОСАН № 6/2007 –ГСРО.

2. American Veterinary Medical Association, 2008, One Health: A New Professional Imperative: Final Report of the One Health Task Force , viewed 10 May 2016, URL: http://www.avma.org/onehealth/

3. American Veterinary Medical Association, 2010, One Health: A New Professional Imperative, viewed 10 May, URL: https://www.avma.org/KB/Resources/Reports/Documents/onehealth_final.pdf

4. Estera Badau, From antibiotic resistance crisis to the “One health approach”: A common international resolution in respond to the food risks globalization (A cross- countries comparison of institutional and political discourses-France and United states). // Agriculture and Food, Journal of International Scienttific Publications, -2016,-Vol. 4, -p. 366-372.

5. Фетисов Е.П., Ш.Розенов // Росийско-Германский ежегодник «Земледела-тель» - МО «Эконива» - Stiftung Zeben and umwelt. – 1977, -С. 5-129.

6. Ходус А.В. Экологическое сельское хозяйство, экологическое природопользование, экологическая маркировка, //09/11/2012 URL: htpp:// xreferat.ru/113/13550-1.

7. Черников В.А., Р.М.Алексахин, А.В.Голубев, А.И.Чекерес и др. М.: Колос, - 2000, - 536 с.

8. Уразаев Н.А., А.А.Вакулин, А.В. Никитин и др. Сельскохозяйственная экология, М.: Колос, 2000, - 304 с.

9. Органическое сельское хозяйство на пути к реальности. Под редакцией И.М.Потравного, РАН, СО, Байк. Инс-т, Природопользования.- М.: Экономика, -2010, -191 с.

10. Продукция органического производства. Правила производства, хранения. Транспортирования. ГОСТ Р 56508-2015. М.: Стандартинформ. -2015, -71 с.

11. Регламент ЕС № 834/2007 об экологическом производстве и маркировке экологической продукции от 28.06.07 – 21 с.

12. «О безопасности пищевых добавок, ароматизаторов и технологических вспомогательных средств» Технический регламент Таможенного Союза 029/2012.

13. Фомичев Ю.П. Никонова Л.А., Дорожкин В.И., Торшков А.А., Романенко А.А., Еськов Е.К., Семенова А.А., Гоноцкий В.А., Дунаев А.В., Ярошевич Г.С., Лашин С.А., Стольная Н.И. Дигидрокверцетин и арабиногалактан – природные биорегуляторы в жизнедеятельности человека и животных, применение в сельском хозяйстве и пищевой промышленности. Монография, М.: Издательский Дом « Научная библиотека» -2017, 701 с.

14. Кедик,С.А., Ярцев,Е.И. Гультяева. Н.В. Спирулина пища XXI века - Москва «ФармаЦентр», 2006, 166 с.

15. Технический регламент Таможенного Союза. ТР ТС 021/2011 «О безопасности пищевой продукции ».

16. Подольников, В.Е. Водоросли в рационах животных / В.Е. Подольников // Животноводство России, №6, -2011.- С.56-57.

17. Глебова И.В., Рыков а.М., Фомичев Ю.П. Влияние премикса на основе цианобактерий Arthrospira platensis на продуктивность лактирующих коров. – Научное и творческое наследие академика ВАСХНИЛ И.С. Попова в науке о кормлении животных. -Матер. Межд. научно-практ. конф. М.: -2018, -С.161-166.

18. Kulpys,J., Paulauskas.E., Pilipavicius,V., Stankevicius,R. Influence of cyanobacteria Arthrospira (Spirulina) platensis biomass additives towards the body condition of lactation cows and biochemical milk indexes. Agronomy Research 7(2), 823-835, 2009.

19. Rimkus M.,Simkus A., Syvys R., Birutis S. Dry powdery fodder additive, supplement or fodder containing algae spirulina platensis . WO2010106468A1

20. Ратошный А., Андреева Н. Спирулина в стартерных комбикормах. // Животноводство России, - 2007, Июнь, - С.59.

21. Петряков В.В. Онтогенетические особенности морфофизиологического состояния свиней под влиянием биологически активного комплекса Spirulina Platensis // Известия Оренбургского ГАУ , -2015,-№3(53), -С.102-105.

22. Grinstead G.S.,Tokach M/D., Dritz S.S.,Goodband R.D., Nelssen J.L.Effects jf Spirulina platensis on growth performance of weaning pigs. -//Animal Feed Science and Technology/--2000, -№83?- 237-247.

23. Nedeva R., Jordanova G., Kistanova E.,Shumkov K., Georgiev K., Abadgieva D.,Kacheva D., Shimkus A., Shimkine A.// Bulgarian journal jf Agricultural Scienct -2014, -20(№3), -P-680-684.

24. Певень В.Г. Спирулина в кормлении племенной птицы. Автореф. дисс. канд. с-х. наук., - Сергиев-Пасад, - 1998, -19 с.

25. Милогородский Е.Н. Фармако-экспериментальное обоснование применения спирулины плптенсис при выращивании цыплят. –Троицк, -2006, -20 с.

References in English

1. Global'naya sistema rannego opoveshcheniya o ser'eznyh boleznyah zhivotnyh, vklyuchaya zoonozy (GSRO) [Global early warning system for serious animal diseases, including zoonoses (GHS)]. // INFOSAN information note No. 6/2007 – GSRO. [in Russian]

2. American Veterinary Medical Association, 2008, One Health: A New Professional Imperial: Final Report of the One Health Task Force , viewed 10 May 2016, URL: http://www.avma.org/onehealth/

3. American Veterinary Medical Association, 2010, One Health: A New Professional Imperial, viewed 10 May, URL: https://www.avma.org/KB/Resources/Reports/Documents/onehealth_final.pdf

4. Estera Badau, From antibiotic resistance crisis to the “One health approach”: A common international resolution in response to the food risks globalization (A cross - countries comparison of institutional and political discourses-France and United states). // Agriculture and Food, Journal of International Scientific Publications, -2016,-Vol. 4, -P. 366-372.

5. Fetisov E. P., sh. Rozenov // Russian-German Yearbook "Farmer-tel" - MO "EkoNiva" - Stiftung Zeben and umwelt. – 1977, -P. 5-129. [in Russian]

6. A.V. Khodus Ehkologicheskoe sel'skoe hozyajstvo, ehkologicheskoe prirodopol'zovanie, ehkologicheskaya markirovka [Ecological agriculture, environmental management, environmental labeling], //09/11/2012, URL: htpp:// xreferat.ru/113/13550-1. [in Russian]

7. Chernikov V. A., Aleksakhin R. M., Golubev A. V., Chekeres A. - M.: Kolos, - 2000, - 536 p. [in Russian]

8. Urazaev N. Ah., Vakulin A. A., Nikitin A. V. Sel'skohozyajstvennaya ehkologiya [Agricultural ecology], M.: Kolos, 2000, - 304 p. [in Russian]

9. Organicheskoe sel'skoe hozyajstvo na puti k real'nosti [Organic agriculture is on the way to reality]. Edited by I. M. Potravny, RAS, SO, Bike. Ins-t, use of natural resources.- M.: Economy, -2010, -191 p. [in Russian]

10. Produkciya organicheskogo proizvodstva. Pravila proizvodstva, hraneniya. Transportirovaniya [Organic production. Rules of production, storage. Transportations]. GOST R 56508-2015. M.: Standardinform. -2015, -71 p. [in Russian]

11. EC regulation No. 834/2007 on environmental production and labelling of environmental products of 28.06.07 – 21 p. [in Russian]

12. "On the safety of food additives, flavorings and technological AIDS" Technical regulation of the Customs Union 029/2012. [in Russian]

13. Fomichev Yu. Nikonov L. A., Dorozhkin V. I., Tishkov A. A. Digidrokvercetin i arabinogalaktan – prirodnye bioregulyatory v zhiznedeyatel'nosti cheloveka i zhivotnyh, primenenie v sel'skom hozyajstve i pishchevoj promyshlennosti [The dihydroquercetin and arabinogalactan – a natural bioregulator in the human and animals, use in agriculture and food industry]. Monograph, M.: Publishing House "Scientific library" -2017, 701 p. [in Russian]

14. Kedik S. A., Yartsev E. I., Gultyaeva. N. V. Spirulina pishcha XXI veka [Spirulina food of the XXI century] - Moscow "Farmatsentr", 2006, 166 p. [in Russian]

15. Technical regulations of the Customs Union. TR CU 021/2011 "On food safety ".[in Russian]

16. Podelnikov, V. E. Vodorosli v racionah zhivotnyh [Algae in the diets of animals] / V. E. Podelnikov // Animal Russia, No. 6, -2011.-P. 56-57. [in Russian]

17. Glebova I. V., Rykov A. M., Fomichev Yu. P. Vliyanie premiksa na osnove cianobakterij Arthrospira platensis na produktivnost' laktiruyushchih korov [Effect of premix on the basis of the cyanobacteria Arthrospira platensis on the productivity of lactating cows]. – Scientific and creative heritage of academician VASKHNIL I. S. Popov in the science of animal feeding. - Matera. Intl. scientific practice. Conf. M.: -2018, -P. 161-166. [in Russian]

18. Kulpys,J., Paulauskas.E., Pilipavicius,V., Stankevicius,R. Influence of cyanobacteria Arthrospira (Spirulina) platensis biomass additives towards the body condition of lactation cows and biochemical milk indexes. Agronomy Research 7(2), 823-835, 2009.

19. Rimkus M.,Simkus A., Syvys R., Birutis S. Dry powder fodder additive, supplement or fodder containing algae spirulina platensis . WO2010106468A1

20. Ratoshny A., Andreeva N. Spirulina v starternyh kombikormah [Spirulina in starter feed]. // Animal Husbandry Of Russia, - 2007, June, -P. 59. [in Russian]

21. Petryakov V. V. Ontogeneticheskie osobennosti morfofiziologicheskogo sostoyaniya svinej pod vliyaniem biologicheski aktivnogo kompleksa Spirulina Platensis [The Ontogenetic characteristics of the morphological and physiological status of pigs under the influence of biologically active complex of Spirulina Platensis] // proceedings of the Orenburg state agricultural UNIVERSITY , -2015,-№3(53), -P. 102-105. [in Russian]

22. Grinstead G. S.,Tokach M/D., Dritz S., Goodband R. D., Nelssen J. L. Effects jf Spirulina platensis on growth performance of weaning pigs. -//Animal Feed Science and Technology/--2000, -№83?- 237-247.

23. Nedeva R., Jordanova G., Kistanova E.,Shumkov K., Georgiev K., Abadgieva D.,Kacheva D., Shimkus A., Shimkine A.// Bulgarian journal jf Agricultural Science -2014, -20(№3), -P-680-684.

24. Peven V. G. Spirulina v kormlenii plemennoj pticy [Spirulina in feeding breeding birds]. Abstract. Diss. kand. s-H. Sciences., - Sergiev-Pasad, - 1998, -19 p. [in Russian]

25. Belogorodsky E. N. Farmako-ehksperimental'noe obosnovanie primeneniya spiruliny plptensis pri vyrashchivanii cyplyat [Pharmaco-experimental substantiation of application of spirulina, platensis in growing chickens]. –Troitsk, -2006, -20 p. [in Russian]