

Effectiveness of the use of biologically active substances in quail farming

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Abstract.

The current challenge in industrial poultry farming is to develop feed additives as an alternative to feed antibiotics. Natural plant-based feed additives have been found to have a positive effect on digestion and the overall poultry health. The main advantages of phytobiotic preparations are their naturalness, better assimilation within the animal's body, low toxicity and no side effects. Phytobiotics are also relatively inexpensive because, unlike their expensive synthetic counterparts, the raw materials for their manufacture are more affordable. According to their different characteristics, phytobiotics can be divided into four groups: herbs (flowering, non-wood and short-lived plants), spices (herbs with a strong odour or taste, usually added to human food), essential oils (volatile lipophilic compounds obtained by cold pressing, steam or alcohol distillation) and resins (oleo-resin, extracts obtained by the action of non-aqueous solvents). The purpose of this review was to examine the composition, properties and use of phytobiotic preparations in poultry farming technology based on an analysis of current scientific publications by domestic and foreign authors. The article provides a far from being complete overview of research into the composition, properties and efficacy of phytobiotics in egg and meat poultry

farming, geese farming, turkey and quail farming indicating that they are in high demand in these industries. In industrial poultry farming, phytobiotics contribute to increasing the overall resistance of the poultry organism, normalising the microflora of the gastrointestinal tract and increasing egg and meat productivity through better assimilation of feed nutrients. However, it should be noted that the number of herbal products is increasing every year and it is necessary to study in detail their properties and use in poultry farming technology.

Keywords: phytobiotic preparations, feed antibiotics, poultry, productivity, safety, immunity.

Introduction. In most countries of the world, the poultry farming industry is one of the most important industries and one of the fastest growing. In Russia, according to "Rosptitsoyuz", in 2018 the leading positions in the structure of poultry slaughter on farms of all categories were held by broilers - 90.2%, then turkeys - 5.4%, technological culling of cross-breed hens - 3%, ducks - 1.0% and geese - 0.4%. The dietary properties of eggs and chicken meat have long been known. Currently, about one third of the Russian population's need for animal protein is satisfied precisely by these products, which are also socially important. In 2018, egg production increased by 0.74% compared to 2017 and poultry production increased by 1.2% to 44.9 bln and 5.0 mln t respectively (Smolentsev *et al.*, 2018).

Recently, the European Union has kept on making the requirements for the production of organic agricultural products stricter, poultry farming included. The European Union's food market is seeing a slowly growing need to produce "organic" eggs, as opposed to producing "organic" poultry meat. At the current stage of development of the Russian agro-industrial complex, the problem is not so much to further increase production, as to improve its quality. Federal Law No. 280-FZ dated August 03, 2018 "On Organic Products and on Amendments to Certain Legislative Acts of the Russian Federation" became one of the important milestones in ensuring the country's food security, creating favorable conditions for human activity, preservation and restoration of soil fertility (Semenov *et al.*, 2018).

Organic products can be obtained by using only high-quality and effective feed additives in industrial poultry production. For many years, feed antibiotics have been the main drug used to increase the assimilation of feed nutrients, improve their digestibility and prevent stress on broiler chickens. However, it should be noted that their use in the gastrointestinal tract of poultry

killed not only pathogenic microflora, but also normal one (Alyokhin *et al.*, 2019).

In the early 1950s, researchers noted the resistance of birds to the antibiotics regularly used to treat people. The next evidence of bacterial drug resistance is the presence of residual drugs in poultry tissue, the imbalance of normal microflora and the transfer of resistance to antibiotics from animal to human. In 2016, the UN General Assembly recognised the use of antibiotics in livestock production as one of the main causes of antimicrobial resistance in humans. A number of infections, including pneumonia, tuberculosis and salmonellosis, already show increased resistance to antibiotics, making it difficult to treat these diseases (Egorov *et al.*, 2018; Galyautdinova *et al.*, 2020).

As a result, there is an emerging interest in studying the impact on productivity and quality of broiler chicken meat of plant-based complexes, which improve poultry safety and high zootechnical performance and contribute to the normalisation of metabolism and intestinal microflora with no harm to the human body. There is an acute need for drugs that do not cause drug resistance and have a pronounced antimicrobial effect, including that on antibiotic resistant strains of microbes. New regulators for intestinal biosynthesis - phytobiotics - provide significant assistance in this situation (Matveeva *et al.*, 2015; Melnik *et al.*, 2020).

Based on the above, the aim of the research was to study the composition, properties and use of phytobiotic preparations in poultry farming technology based on the analysis of modern scientific publications of domestic and foreign authors.

Materials and Methods. The methodological basis for the research was the scientific developments of domestic and foreign authors studying modern technologies in meat and egg poultry farming, geese farming, turkey and quail farming. Generally accepted methods were used in the research process: analysis, comparison, generalisation; special scientific methods: abstract-logical, economic-statistical.

Results and Discussion. The study of the impact of phytobiotics on the microbial intestines of birds of different genetic lines is of significant interest. Reducing the risk of developing infectious pathologies is associated with the formation of a healthy microbiota of the digestive tract, which is capable of providing high resistance to colonisation of the intestines by pathogens through the synthesis of volatile fatty acids, bacteriocins and other compounds that inhibit the growth and development of pathogenic species. It

is known that micro-organisms, by interacting with each other as well as with the host organism, can have a profound effect on the immunity, non-specific resistance to infections and general bird life processes. In addition, the active participation of the bird intestine microbial community in digestive processes in the breakdown of complex polysaccharides and proteins, in the use and formation of nutrients, in the synthesis of vitamins and in the development of intestinal villi that increases the absorption surface, is also shown. At the beginning of the 21st century, the European Union developed new principles for poultry feeding. As a result, feed antibiotics were completely eliminated in poultry farming and instead biologically active additives such as probiotics, prebiotics and phytobiotics came to the fore (Khristoforovich *et al.*, 2016).

Plant extracts, also known as phytobiotics, are used to feed animals, in particular for antimicrobial, anti-inflammatory, antioxidant and anti-parasitic purposes. Many plants are multifunctional, and the biologically active substances isolated from them have useful properties. According to their different characteristics, phytobiotics can be divided into four groups: herbs (flowering, non-wood and short-lived plants), spices (herbs with a strong odour or taste, usually added to human food), essential oils (volatile lipophilic compounds obtained by cold pressing, steam or alcohol distillation) and resins (oleo-resin, extracts obtained by the action of non-aqueous solvents). The time to collect the plants or the region where they grow has a significant impact on the amount of biologically active substances in them. For example, higher antimicrobial activity is shown by essential oils, which are obtained immediately after the plant blooms in summer. Essential oils also stimulate the appetite of animals through their aromatic properties and stimulate enzyme production, thereby improving digestion (Rodionov *et al.*, 2019).

Essential oils are now increasingly being used in poultry farming as a substitute for antibiotics and synthetic antioxidants. For example, the researches of N.V. Yunyaeva *et al.* confirmed the antibacterial and antidepressant properties of oregano natural essential oil, which was added to the diet of broiler chickens during the first five days of their lives. The use of essential oils of oregano, thyme, cinnamon and chilli pepper as growth stimulants in poultry farming has been considered to have a positive effect (Smolentsev *et al.*, 2019).

Lumber waste can be used as the basis for phytobiotics. For example, wood greenery, which contains valuable biologically active substances and can be used as feed additives for animal and poultry production, makes it a valuable

raw material for agriculture. The production of the additive, based on essential oils of needles, is based on the extraction of biologically active substances from wood greenery using a selective extractant representing a composition of polyhydric alcohol. The inclusion of this supplement in the diet of broilers helps to stimulate their growth, ultimately increasing the biological value of their carcasses (Drobot *et al.*, 2019).

PHARMATAN is a balanced complex on the domestic market of phytobiotics, the main ingredient of which is chestnut wood extract obtained by water extraction without the use of chemical reagents. The extract contains several dozens of active substances (flavonoids, organic acids and their salts, saponins, mono and polysaccharides, essential oils, micro and macro elements, etc.), the main of which are hydrolysable ellagitannins. To enhance the effect of ellagitannins, PHARMATAN additionally includes butyrate and calcium lactate, essential oils of cinnamon, oregano and chilli pepper for poultry. Numerous studies of PHARMATAN on egg-laying stock, broilers and turkeys have proven its effectiveness: it increases the safety of the stock, increases egg production (this effect is especially clearly visible on "old laying hens") and improves the quality of eggs (the number of damaged hull eggs, cracks, contaminated eggs decreases), increases feed conversion, average daily growth and the final live weight of broilers (Holodova *et al.*, 2019).

Feed additives for poultry with different combinations of medicinal plants are known, e.g. foalfoot, plantain, tansy, celandine, white sweet clover, yarrow, wild chamomile, urticadioica or oregano, John's-wood. Other combinations of medicinal plants are also possible, the use of which increases immunity, the tonus of the bird's organism and the elimination of toxic substances (Ilyasovich *et al.*, 2016).

The application of phytogenic feed additive AdiCox Sol PF®, which is a concentrated and stabilized plant extracts: white mustard, calamus root, black pepper, soapwort in the form of a solution in the drinking of broiler chickens Ross-308, contributed to an increase in live weight at the end of the experiment and the average daily gain in live weight by 5%, increased stock safety by 7%, reduced feed costs by 1 kg of live weight gain by 16%, and helped obtain a higher value of the broiler productivity index. All this resulted in a 10.2% increase of profit from the sale of the stock in the pilot group.

N.N. Lantseva *et al.* conducted a research to determine the impact of florabisphytobiotic on the zootechnical indicators of broiler chickens of ISA F 15 cross-breed and their physiological state. Florabis is a complex of Siberian

fir triterpene acids with cobalt ions. These acids have pronounced antiviral, bactericidal and immunomodulatory properties. The studies found that the chickens in the pilot group receiving the phytobiotic studied had a 3.8% higher live weight at the end of the study compared to the control group, an average daily gain of 3.7% and a 6.7% lower feed cost per kg of live weight gain. The calculation of feed digestibility coefficients has shown that the introduction of florabis into the basic diet increases the digestibility of feed nutrients. It has been noted that phytobiotics has prebiotic properties, which contribute to the development of birds' normoflora, producing the necessary enzymes that activate symbiotic digestion. On the whole, the author's studies of the chemical, morphological, biochemical and immunological status of the comparison groups broilers have proved the positive impact of florabis on the physiological state of the bird during the intensive fattening period (Rozhentsov *et al.*, 2019).

Z.N. Alekseeva *et al.* studied the effectiveness of the use of cedar soft resin and florabis as phytobiotics in experiments on the young Haysex White cross-breed. The authors have found that a slightly greater effect in terms of productivity is seen when using cedar soft resin (the average live weight of poultry increases by 4.1%, the average daily increase in live weight by 5.6%, and feed costs per 1 kg of live weight gain decrease by 2.9%). Economic efficiency from the use of cedar oil was 3.6% higher in terms of profitability and 3.0% higher in terms of florabis content.

Phytobiotics can be fed to birds as plants in natural or dry form. For example, the inclusion of fresh nettle in the diet and the flour prepared from it help to save up to 30% in mixed fodder, and also compensate the need for protein by 19-21%, for vitamins by 55- 75% and for microelements by 100%. This additive significantly improves the flavour of poultry meat and eggs, while also increasing their biological value. Peppermint oil has a disinfectant effect when decomposed in the gastrointestinal tract, and its antioxidant properties and ability to stimulate the secretion of saliva and gastric juice are also observed. The use of fir meal rich in vitamins and minerals in the poultry's diet has a positive effect on its safety, growth rates and normalises its metabolism. Biologically active additive based on bee products Vinyvet has a growth stimulating effect, has a positive effect on the gastrointestinal tract of poultry, expanding the absorption surface of the mucous membrane of the small intestine. In addition, the drug has antiseptic properties (Yakupov *et al.*, 2020).

The use of oak bark extract (*Quercus cortex*) in poultry feeding contributed to improved feed eatability, and the combined use of the enzyme supplement Glucolux-F with oak bark extract stimulated digestive processes. The introduction of purified *Quercus cortex* extract and enzyme preparation into the diet of broiler chickens has had a positive impact on their hematological performance, as well as their growth and development. It was revealed that the median of their blood biochemical indicators was within the recommended values. The activity of AlAT, LDG, creatine kinase was higher in the pilot groups regarding control. There was also a tendency for triglyceride levels in the blood of the chicken broilers of the experimental groups to decrease relative to the control level. The introduction of *Quercus cortex* extract into poultry diets has no negative impact on the mineral, lipid, carbohydrate and protein metabolism of birdsorganisms (Smolentsev *et al.*, 2020).

Franciosini M.P. et al. studied the impact on the productive performance of broiler chickens, their immunity and intestinal microbiocenosis of aquatic oregano and rosemary extracts. Extracts of these herbs increased the immunity of broilers, balanced the intestinal microflora needed for digestive processes and protection against enteropathogens, and improved the poultry productive qualities.

Feeding broiler chickens with echinacea purple in combination with probiotic contributed to a 21% increase in live weight gain and up to 100% in preservation, as well as to a 17% reduction in feed costs. The introduction of echinacea purple shredded dry grass into the diet of broiler chickens of the pilot group increases their average daily growth at the start of the growing stage, so that once feeding of echinacea purple had ceased at the end of the growing stage, broiler chickens showed an increase of 18% compared to the control group (Galyautdinova *et al.*, 2020).

Thyme extract has a positive effect on the physiological properties of the poultry organism, such as normalising metabolism, increasing the use of feed nutrients, increasing of productivity and growth intensity. The inclusion of thyme extract in the diet of ISA F-15 broiler cross-breed chickens contributed to an increase in live weight and average daily gain in all age periods, improved safety and reduced feed costs by 1 kg of live weight gain. The European Productivity Index has increased as a result of lower feed costs and improved safety of broiler populations in the pilot groups. There was a positive impact of thyme extract on the anatomical cutting of broiler chicken

carcasses and no adverse impact on the development of broiler internal organs, as well as unreliable differences in the chemical composition and amount of essential amino acids in the pectoral muscles of broiler chickens (Gracheva *et al.*, 2020).

The use of Apex, a natural fodder additive for broilers, which includes garlic allicin, helps to improve their zootechnical growth indicators: increase in live weight and average daily growth by 5.5%, safety - up to 96%, reduction of feed costs by 1 kg of live weight gain by 2%), allowing to reduce the cost of final products and increase profitability. Similar results were obtained with the combined use of Apex and the Emicidin antioxidant. In this option of growing broilers, the cost per kg of their meat was 3.66 RUB lower and profitability 4.7% higher (Melniket *et al.*, 2020).

E.R. Nuraliev, I.I. Kochish found that the phytobiotic Provitol, which contains probiotic, essential oils and plant extracts, contributes to the formation of beneficial microflora and the normalizing digestion in egg production poultry. In the first series of trials on Rodonit 3 cross-breed chickens, they obtained data on the positive impact of the studied phytobiotic on their live weight in 60 and 120 days (14.6-18.1 and 24.9-35.1% respectively higher than the values in the control group), the average daily gain in live weight (22.8-35.0% higher than the control group), and safety (3.2-3.9% higher than the control group). In the second series of tests conducted on laying hens of the Hisex Brown cross-breed, they found that the egg-bearing capacity of birds in the pilot groups increased by 4-7% in two months compared to the same indicator in the control group. As a result of the production audit, they have seen a 9.8% increase in profitability, even though there are additional costs associated with the acquisition and use of phytobiotics (Ivanova *et al.*, 2020).

Feed additive based on Intebio essential oils, which has antimicrobial activity, antioxidant effect and anti-inflammatory effect, is used to increase the safety and productivity of broiler chickens. For example, studies on the impact of phytobiotics on meat productivity and meat quality in Cobb 500 cross-breed broilers have provided evidence of the positive impact of Intebio on the indicators studied. So, in the experimental group, the birds of which were fed with phytobiotics, the safety of the poultry stock increased to 100% compared to the control group, feed costs per kg of growth decreased by 3.0%, daily average weight gain increased by 5.2%; morphological composition of poultry carcasses was also improved. The results of the experiments on the inclusion of Intebio in the diet of broiler chickens of Ross-308 cross-breed made it

possible to note the positive impact of phytobiotic on the body weight gain of broilers, intestinal microflora and immune status. A strengthening effect of Intebio on the expression of genes related to productivity and disease resistance in laying hens has been established, explaining at the molecular level the previously observed positive impact of phytobiotics, which contributes to increased productivity and improved preservation of poultry. The experiments carried out to include Intebio in the feed of young meat chickens of B5 and B9 lines, selection of GSC "Smena" allowed to get almost the same poultry live weight. The development of the reproductive organs of birds females (ovaries and ovarian tube) and males (testes) in both the control and experimental groups was within normal limits without significant differences. Both breeds of chickens have seen significant changes in the bacterial community of duodenal content (Yusupov *et al.*, 2020). The domestic symbiotic ProStor contains live sporeforming bacteria *Bacillus subtilis*, lactic acid microorganisms, products of their metabolism, autolysate of yeast, mineral salts, carbohydrates, phytosanitary additives (purple echinacea grass and spotted thistle down fruits). It was noted that the inclusion of ProStor in the feed of young chickens increases their growth intensity and viability, which later in their adult state were characterized by high natural resistance, safety and productivity. In the first series of experiments on young chickens, the homogeneity and safety of young chickens raised to replace adults who received the drug was higher than in the control group. In the second series of experiment the application of ProStor in the technology of keeping the parent stock of meat chickens has a positive impact on the safety of poultry and contributes to increased egg production, the yield of hatching eggs, the percentage of hatching chickens, and reduced feed costs when growing, which leads to increased profits (Hairullin *et al.*, 2020).

The use of ProStor additive in the feed of broiler chickens helps increase their live weight, average daily gain, feed preservation and conversion, which finds its own reflection in the profitability increase of growing broiler chickens in industrial production conditions. Phytobiotic AdiCox AP is a product of synthesis of specially prepared plant extracts with essential oils and selected phytoncidal fractions. It contains 24 phytoncides. The main advantages of this phytobiotics are: the ability to increase the body's overall resistance to infections; the ability to stimulate the secretion of gastrointestinal juice, thereby improving the digestibility of feed nutrients and their absorption. Ultimately, poultry gain weight in a shorter time

and feed conversion rates are also significantly improved (Kalyuzhny *et al.*, 2020).

Positive experience in the use of phytobiotics in geese farming has been obtained. For example, the plant preparation Liv 52 Vet has been proven to be an effective herbal remedy containing Capparis, chicory, black nightshade, terminaliaarjuna, western cassia, yarrow, Galician tamarisk and iron oxide. The active ingredients have been processed over extract vapors from a mixture of the following plant raw materials: white eclipta, gale of the wind, boerháviadiffúsa, heart-leaved moonseed, garden radish, embeliaribes, chitrak, currant embelia, myrobalan, drug fumitory. Studies carried out on geese of the Italian white breed parent flock in the experimental group, which received Liv 52 Wet as part of the feed, showed an increase in red blood in the middle of the egg-laying period, as well as an activation of the immune status of the poultry organism. In the experimental group of Italian white goose broilers, whose diets included the phytobiotic Liv 52 Wet, an increase in protein metabolism, tissue respiration rate and increased phagocyte activity were found. On average, 5.1% more eggs were obtained from the goose of the experimental groups that received Liv 52 Wet than the control group during the egg-laying period; the average egg-laying rate was 4.0% higher; the egg-laying intensity was 1.2% higher and the peak egg-laying rate 3.3% higher.

The results of a comprehensive egg quality assessment showed some superiority in eggs obtained from goose of experimental groups who got Liv 52 Wet into their feed. For example, at the end of egg-laying, the goose from experimental groups had a large mass of eggs - by 7.0% on average; egg density - by 0.3%; egg volume - by 6.8%; egg shape index - by 0.8%; Haugh unit - by 5.2%. The inclusion of Liv 52 Vet phytobiotic in the feed for goose broilers had an immunostimulating effect; it helped to increase their natural resistance levels. Also, the broiler goose with Liv 52 Wet mixed feed in the ration were characterized by high meat productivity, lower moisture content and higher concentration of protein in muscle tissue as well as high energy value of pectoral and thigh muscles.

Phytobiotics in goose farming are also used as substances with antioxidant and membrane-protective properties. For example, the addition of vegetable phytobioticmacleayacordata, "green buckwheat" and a mixture of onion and buckwheat husks contributed to 100% deworming, as well as induction of antioxidant resources, which was confirmed by reducing to

physiological norm the activity of catalase and compensatory strengthening of superoxide dismutase and the overall antioxidant activity.

Phytobiotics have also found their application in turkey farming. For example, a natural growth stimulant - coniferous energy supplement (CES) - contains essential oils of needles and a selective extractant. Studies on the impact of CES on the blood biochemical parameters of the Universal turkey cross-breed showed an increase in the concentration of total serum protein in turkeys receiving phytobiotics. This indicates a high level of metabolism in their bodies, which is confirmed by the high growth rate of turkeys for growing and fattening.

An equally promising area is the use of phytobiotics in quail farming. For example, the inclusion in the diet of the Pharaoh quails of the breed Sangrovet, a vegetable feed additive consisting of alkaloids extracted from the macleayacordata, brown juice and green lucern paste, had a positive impact on the safety of quails, their growth dynamics and feed conversion. Dandelion officinalis inflorescences added to the diet of Japanese egg production quails stimulate basic and ionic metabolism, contribute to the mass increase of eggs and carotenoids in the egg yolk, as well as cumulation of Cu, Mn, Ni, Pb, Cd, Co and Fe in the eggs.

Conclusion. Thus, this far from being complete overview of research on the composition, properties and effectiveness of phytobiotics in egg and meat poultry farming, geese farming, turkey and quail farming indicates their high demand in these industries. In industrial poultry farming, phytobiotics contribute to increasing the overall resistance of the poultry organism, normalising the microflora of the gastrointestinal tract and increasing egg and meat productivity through better assimilation of feed nutrients. However, it should be noted that the number of herbal products is increasing every year and it is necessary to study in detail their properties and use in poultry farming technology. It must also be said that poultry farms themselves are reluctant to give up feed antibiotics in favour of phytobiotics or any other biologically active additives.

There is a need to expand research into the mechanisms of phytobiotics action, taking into account the physiological characteristics of the organism, the specifics of feeding and the technology for keeping different age-sex groups of poultry. With the entry into force of the Federal Law "On Organic Products and on Amendments to Certain Legislative Acts of the Russian Federation", research into the development of organic (environment friendly)

poultry production technologies is promising. In many ways, poultry production, especially farming, may become a driver of organic agriculture.

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