DOI: 10.29326/2304-196X-2022-11-2-129-134

The use of Kutikulin for treatment and prevention of gastrointestinal diseases in calves and piglets

M. V. Koryukina[1], V. N. Makarova[2], O. B. Badeeva[3], I. N. Simanova[4]

Vologda Branch of the Federal State Budget Scientific Institution "Federal Scientific Centre VIEV" (Vologda Branch of the FSC VIEV), Vologda, Russia

[1] *https://orcid.org/0000-0002-6250-1922, e-mail: marischka7786@mail.ru*

[2] *https://orcid.org/0000-0002-1687-5173, e-mail: veramakarova2015@yandex.ru*

[3] *https://orcid.org/0000-0002-2708-799X, e-mail: oksanabadeeva@mail.ru*

[4] *https://orcid.org/0000-0001-5264-3815, e-mail: irinasimanowa@gmail.com*

SUMMARY

The global economy dictates more and more stringent requirements for the quality and volumes of products consumed. Veterinary professionals have to look for medicinal products that have a sparing effect on the animal body and, at the same time, are capable of eliminating disease causes. The paper presents the results of tests of Kutikulin, a product made at the Vologda Branch of the FSC VIEV, which consists of chicken gizzard cuticle containing a keratoid secretion and a number of biologically active enzymes. It is a non-toxic, water-insoluble, odourless yellow-green powder with a bitterish taste. When Kutikulin was used to treat newborn calves with a mild dyspepsia resulting from various alimentary causes, the disease duration averaged 2.9 days, recovery rates in the groups were approximately the same (96.6–96.9%). Kutikulin treatment of older calves allowed to reduce the duration of treatment by almost a day, to increase recovery rates by 4.8% and to decrease the number of deaths by 1.6 times. When used for preventive purposes in weaned piglets, Kutikulin helped to decrease morbidity in groups 1, 3 and 5 (test groups) by 2.7, 8.9 and 1.8 times, respectively, as compared with control groups. Its preventive effectiveness was found to be the highest in group 3 (test) piglets that received Kutikulin on a group basis with a liquid feed at a dose of 1.0 g once a day during 3 consecutive days. Along with a shorter disease duration, test group animals also demonstrated less pronounced clinical symptoms. Thus, the use of Kutikulin reduces gastrointestinal disease morbidity and mortality in calves and piglets.

Keywords: treatment, prevention, gastrointestinal diseases, calves, piglets, Kutikulin

For citation: Koryukina M. V., Makarova V. N., Badeeva O. B., Simanova I. N. The use of Kutikulin for treatment and prevention of gastrointestinal diseases in calves and piglets. *Veterinary Science Today*. 2022; 11 (2): 129–134. DOI: 10.29326/2304-196X-2022-11-2-129-134.

Conflict of interest: The authors declare no conflict of interest.

For correspondence: Marina V. Koryukina, Researcher, Vologda Branch of the FSC VIEV, 160009, Russia, Vologda, ul. Chekhova, 10, *e-mail: marischka7786@mail.ru.*

УДК 619:636.2/.4.053.2:59.084:616.33/.34:615.375.36

Применение препарата «Кутикулин» для лечения и профилактики желудочно-кишечных заболеваний у телят и поросят

М. В. Корюкина[1], В. Н. Макарова[2], О. Б. Бадеева[3], И. Н. Симанова[4]

Вологодский филиал ФГБНУ «Федеральный научный центр – Всероссийский научно-исследовательский институт экспериментальной ветеринарии имени К. И. Скрябина и Я. Р. Коваленко Российской академии наук» (Вологодский филиал ФГБНУ ФНЦ ВИЭВ РАН), г. Вологда, Россия

[1] *https://orcid.org/0000-0002-6250-1922, e-mail: marischka7786@mail.ru*

[2] *https://orcid.org/0000-0002-1687-5173, e-mail: veramakarova2015@yandex.ru*

[3] *https://orcid.org/0000-0002-2708-799X, e-mail: oksanabadeeva@mail.ru*

[4] *https://orcid.org/0000-0001-5264-3815, e-mail: irinasimanowa@gmail.com*

РЕЗЮМЕ

Мировая экономика диктует все более жесткие требования к качеству и объему потребляемой продукции. Специалисты в области ветеринарии вынуждены осуществлять поиск лекарственных средств, которые оказывают щадящее действие на организм животных, но при этом способны устранять причины заболевания. В данной статье представлены результаты испытания изготовленного на базе Вологодского филиала ФГБНУ ФНЦ ВИЭВ РАН препарата «Кутикулин», состоящего из кутикулы мышечного желудка кур, содержащей кератоидный секрет и ряд биологически активных ферментов, и представляющего собой нетоксичный и нерастворимый в воде порошок желто-зеленого цвета, горьковатого вкуса, без запаха. При применении с лечебной целью препарата

«Кутикулин» новорожденным телятам с легкой формой диспепсии, вызванной различными причинами алиментарного характера, продолжительность болезни составила в среднем 2,9 дня, процент выздоровевших в группах был примерно одинаковый – 96,6–96,9%. У телят старшего возраста лечение препаратом позволило уменьшить длительность лечения почти на сутки, повысить процент выздоровевших на 4,8%, снизить число павших в 1,6 раза. Использование препарата «Кутикулин» с профилактической целью у поросят-отъемышей сократило заболеваемость в первой, третьей и пятой опытных группах по сравнению с контрольными в 2,7; 8,9 и 1,8 раза соответственно. Наиболее высокая профилактическая эффективность установлена у поросят третьей опытной группы, которые получали препарат групповым методом с жидким кормом в дозе 1,0 г один раз в сутки 3 дня подряд. У подопытных животных помимо сокращения периода заболевания отмечали уменьшение степени выраженности клинических симптомов. Таким образом, применение препарата «Кутикулин» снижает заболеваемость и отход телят и поросят при желудочно-кишечных заболеваниях.

Ключевые слова: лечение, профилактика, желудочно-кишечные заболевания, телята, поросята, препарат «Кутикулин»

Для цитирования: Корюкина М. В., Макарова В. Н., Бадеева О. Б., Симанова И. Н. Применение препарата «Кутикулин» для лечения и профилактики желудочно-кишечных заболеваний у телят и поросят. *Ветеринария сегодня*. 2022; 11 (2): 129–134. DOI: 10.29326/2304-196X-2022-11-2-129-134.

Конфликт интересов: Авторы заявляют об отсутствии конфликта интересов.

Для корреспонденции: Корюкина Марина Вениаминовна, научный сотрудник Вологодского филиала ФГБНУ ФНЦ ВИЭВ РАН, 160009, Россия, г. Вологда, ул. Чехова, 10, *e-mail: marischka7786@mail.ru.*

INTRODUCTION

Among pathologies reported on animal farms of the Vologda Oblast, maximum economic losses are associated with gastrointestinal diseases that especially affect young animals. The first 10–15 days after birth, in particular the colostral stage, is the most difficult period as regards young animals' survival. The predisposing cause of gastrointestinal disorders (dyspepsias) is decreased body resistance in newborn calves arising from nutritional deficiencies and inappropriate housing conditions of mother cows. Cows receiving deficient diets give birth to calves that demonstrate reduced enzyme secretion by digestive glands and hydrolysis product malabsorption in the intestine. Such animals typically have gastrointestinal disorders. In view of this, the use of products, which stimulate and normalize enzyme secretion by digestive glands, gains a practical importance. The creation of adequate conditions for calving in specially designated pens and subsequent housing of young animals, as well as timely and sufficient colostrum feeding allow to prevent the disease in most cases. At present, tissue-based products are widely used for gastrointestinal disease prevention and treatment in young animals, as well as for the improvement of their performance [1].

Tissue-based products have been known since the first century AD, with the roots of various plants being used as a base for them at that time. Roman scientists Columella, Apsyrtus and Vegetius reported successful subcutaneous administration of hellebore root to cattle and pigs.

The quality and ecology of products for human consumption, freedom from chemicals and balanced diets are of high importance nowadays. Products of animal origin play an essential role in the diet since they are a complete source of protein [2, 3].

Raw material quality is based on multiple factors such as processing, manufacture, safety. But the focus should be on product quality, which initially depends on animals' housing conditions, their diets and treatment prescribed where necessary. It is known that the unlimited use of antibiotics affects product quality. This topic is particularly relevant in the light of the fact that drugs of such kind are commonly used on farms in order to reduce treatment duration, while spending as little money as possible. As a result, certain disease-causing bacteria develop resistance to antibiotics and thus become insusceptible to drugs at the very time when their administration is vitally important. The use of expensive, not readily available antimicrobials has a negative effect on the economic performance of agricultural establishments. It is therefore appropriate to replace them with products that improve digestion and absorption of nutrients in the gastrointestinal tract [4, 5].

Tissue-based products and lysates prepared by hydrolysis from various organs and tissues are widely applied in veterinary practices. In particular, treatment involves the use of tissue-based products prepared from liver and spleen of cattle, testes of male horses and rams. These substances used in minimum quantities to supplement feeds or as mucous membrane applications promote the growth and development of young animals, increase weight gains in fattening livestock. They also have a favourable effect on the body's natural resistance parameters (serum lysozyme and bactericidal activity, phagocytic activity of leukocytes), morphological and biochemical blood profile (erythrocyte and leukocyte counts, hematocrit, erythrocyte sedimentation rate (ESR), hemoglobin and total protein levels) [6, 7].

Tissue therapy is based on the use of preserved tissues and products prepared from them for the treatment of animals, as well as for the improvement of their performance. Tissue-based products contain protein components that stimulate certain body organs and tissues. Their effectiveness largely depends on an animal's species, age, the functional state of its nervous system or specific features of a disease. The use of tissue-based products leads to a 15–30% rise in weight gains in animals and helps to increase meat production [8, 9].

Tissue therapy, in combination with adequate feeding and optimal housing conditions, has a beneficial effect irrespective of the form of the disease – it improves the body's physiological functions, thus helping to cope with pathological processes. Besides, complications and side effects are extremely rare [10].

Biostimulants are widely used for the treatment of obstetric and gynecological disorders in livestock: chronic endometritis, elementary ovarian dystrophy. Tissue-based products used when treating infectious diseases have a systemic stimulating effect on the body, and this is of practical importance for the enhancement of specific immunity factors and a better diagnosis of chronic infectious diseases [11, 12].

Young animals, first and foremost newborn ones, are at high risk of death from dehydration because of inadequate water metabolism regulation arising from incomplete functional development of kidneys. Such animals shall therefore be subjected to treatment without any delay. Sometimes it is enough to administer a normal saline solution, infusions and decoctions of medicinal herbs, compound electrolytic solutions, such as Ringer-Locke's solution, I. G. Sharabrin's solution [13, 14].

Another important aspect is the development of immunity in animals in early life. It is at this time that the enhancement of immune system is indispensable for the improvement of general body resistance to diseases. Considerable attention should be given to the enhancement of body defences, resistance to environmental conditions, while taking into account the length of time from the start of treatment till full recovery. For the improvement of these parameters, the animal body requires nutrients, but feeds consumed on a daily basis or bioadditives do not always contain the sufficient amounts of them. This can be accomplished by using products of plant and animal origin [15, 16].

One of known tissue-based products is the product made according to V. P. Filatov's method. This scientist was the one who began the studies of biogenic stimulants in 1933. Biogenic stimulants are produced as a result of animal tissue preservation at low temperatures and plant tissue preservation in darkness. They are non-protein substances, which are primarily represented by malic, citric, lactic, succinic, carboxylic acids and two amino acids: arginine and glutamic acid.

According to many authors, the range of biogenic stimulant application in veterinary and human medicine is rather wide. Veterinarian K. Kiselev (1898) used male horse testis extract to treat pleuroneumonia-affected horses and succeeded in bringing them to full recovery. Preserved tissues prepared according to V. P. Filatov's method can be used as a separate medicinal product, as well as in combination with antibiotics and vitamins [10, 13, 17].

An experiment was conducted at the Kazan State Academy of Veterinary Medicine named after N. E. Bauman to study the product made according to V. P. Filatov's method. The product consists of tissues of parenchymatous organs (liver, spleen) from healthy livestock, supplemented with trace elements. The experiment was carried out in twelve 3-month-old calves. The product was administered in the middle third of the neck at a dose of 10 ml every 7 days for 4 weeks. Based on the test results, it was concluded that the functional activity of immune system had enhanced, there had been an increase in the blood levels of total protein by 6.7%, phosphorus by 3.9%, calcium by 3.4%, albumins by 5.4%, *α*-globulins by 7.1%, *β*-globulins by 8.3%, as compared with control animals [18].

The Vologda Veterinary Research Station, now known as the Vologda Branch of the FSC VIEV, developed and patented a biostimulant – Splenivit, a bovine spleen extract supplemented with vitamin B_{12}[1]. It is a sterile fluid of a deep brown colour with a reddish hue, which has no toxic and anaphylactogenic properties. Its effect on the general resistance was determined in pregnant sows. The biostimulant was administered to the test group (132 animals) at a dose of 5 ml 30, 20, 10 days before farrowing. The product was not administered to the control group (172 animals).

The number of stillbirths in sows that had received the biostimulant was reduced by half, piglet survival rate at weaning rose by 2.8 times, and weaner output increased by 2.2 animals.

After double administration of Splenivit, 20-day-old piglets demonstrated a significant increase in hemoglobin levels by 14.7%, an increase in erythrocyte counts by 33.3%, total protein levels by 12.3%, *γ*-globulin levels by 67.3%, phagocytic activity and phagocytic index of neutrophils by 13.2 and 16.7%, respectively, whereas blood leukocyte counts and the number of stress-affected piglets decreased by 39.3 and 25.0%, as compared with controls ($P > 0.95–0.99$).

After triple administration of Splenivit, the most significant differences among 30-day-old piglets consisted in an increase in erythrocyte counts by 37.2%, total sugar levels by 13.5%, neutrophil phagocytic activity by 79.6% ($P > 0.95–0.99$), whereas lymphocyte and leukocyte counts and the number of stress-affected piglets decreased by 11.3, 51.0, 50.0% ($P > 0.95–0.99$).

The tests of blood samples from calves, to which Splenivit had been administered three times at a 7-day interval starting from the age of 2 days, showed an increase in the following parameters: hemoglobin levels by 13.6%, serum bactericidal activity by 36.0%, neutrophil phagocytic activity by 77.8%, complement levels by 60.0%, monocyte counts by 53.0%, whereas band neutrophil counts and sialic acid levels decreased by 47.5 and 20.3%, respectively.

The percentage influence of Splenivit within the entire complex of factors leading to changes in hemoglobin levels, serum bactericidal activity, neutrophil phagocytic activity, complement levels, sialic acid levels, band neutrophil and monocyte counts, was 13.6, 13.5, 13.9, 10.0, 14.3, 15.8, 14.9%, respectively ($P > 0.95–0.99$).

Test group morbidity and mortality were 2.2 times lower in calves and, respectively, 2.7 and 4.1 times lower in piglets, as compared with the control groups. Besides, the number of hypotrophic piglets at weaning decreased by 2.5 times. Thus, Splenivit used in diseased newborn calves and piglets enhances body defences, improves growth and development, reduces morbidity and mortality in young animals.

[1] Gorbunov A. P., Masanskaya V. V. Sposob polucheniya biostimulyatora «Splenivita» iz selezenki zhivotnykh = The method for Splenivit biostimulant preparation using animal spleen. Copyright certificate No. 1695869 A1 USSR, Int. A23K1/00 (2000-01-01). Vologda Veterinary Research Station. No. 4753414/15. Date of filing: 30.10.1989. Date of publication: 07.12.1991. Bull. No. 45. (in Russ.)

Another contemporary example of the use of immunomodulators in veterinary medicine is an experiment carried out by the researchers of the Belgorod State Agricultural Academy in treating functional dyspepsia in newborn calves with Thymogen. The calves of one of the test groups were intramuscularly injected with 0.01% Thymogen solution at a dose of 10 ml for 10 days starting from the second day after birth and Pharmasin-50 at a dose of 5 ml for 4 days. As a result, protein metabolism parameters, such as *α*- and *β*-globulin levels, were found to increase by 52.8% by day 10, and this is indicative of Thymogen effect on immune system establishment, general physiological state of animals, normalization of impaired metabolism, as well as of its possible role in disease prevention [19].

The Department of Infectious and Non-Contagious Pathology of the Federal State Budgetary Educational Institution of Higher Education "Ural State Agrarian University" carried out tests of a plant tissue-based product in the form of medicinal herb infusions supplemented with Dorogov's stimulant ASD-2F. The infusion was given to calves once a day during 7 days. Based on the test results, the product demonstrated a high antimicrobial activity against *Escherichia coli* and *Salmonella typhimurium* strains isolated from diseased animals. It was also found that the duration of treatment in calves affected with colibacteriosis and salmonellosis became shorter and their hematological parameters improved [20].

Thus, the development and use of products of animal and plant origin for gastrointestinal disease treatment and prevention are of great current relevance.

Table 1
The results of Kutikulin treatment in calves

Groups	Number of animals	Disease duration, days	Treatment effectiveness		Died	
			Recovered, animals	%	Animals	%
Newborn calves						
group 1 (test)	174	2.9	168	96.6	6	3.4
group 2 (control)	97	2.9	94	96.9	3	3.1
Older calves						
group 3 (test)	13	4.5	12	92.3	1	7.7
group 4 (control)	8	5.7	7	87.5	1	12.5

Table 2
The results of Kutikulin use for prevention purposes in weaned piglets

Groups	Number of animals	Product dose, g	Became diseased		Died	
			Animals	%	Animals	%
group 1 (test)	250	0.5	6	2.4	1	0.4
group 2 (control)	220	–	16	7.3	2	0.9
group 3 (test)	130	1.0	7	5.4	–	–
group 4 (control)	138	–	62	44.9	7	5.1
group 5 (test)	576	0.5	138	24.0	37	6.4
group 6 (control)	580	–	251	43.3	46	7.9

MATERIALS AND METHODS

Kutikulin, a product consisting of chicken gizzard cuticle that contains a keratoid secretion and a number of biologically active enzymes, was developed at the Vologda Branch of the FSC VIEV. It is a non-toxic, water-insoluble, odourless yellow-green powder with a bitterish taste.

Kutikulin was tested for its treatment effectiveness in diarrhea-affected calves of different ages on several farms of the Vologda Oblast. The following groups of animals were formed: two groups of newborn calves under the age of 10 days – group 1 (test, 174 calves) and group 2 (control, 97 calves), as well as two groups of older calves aged up to 30 days – group 3 (test, 13 calves) and group 4 (control, 8 calves). The treatment of animals in all the groups was started at the onset of the first signs of the disease (diarrhea) according to the regimen adopted on the farms. The test group calves were given Kutikulin once a day instead of antibiotics. The product was administered at a dose of 1.5–2.0 g with a liquid provided to the calves in the morning 20–30 minutes before feeding, the treatment period was 3–4 days. Before giving the powder, the amount of milk or colostrum was reduced to half.

Kutikulin was tested for its preventive effectiveness in weaned piglets (1,894 animals) with a view of preventing gastrointestinal disorders during the first days of weaning and adaptation to a new milk free diet. The product was administered on a group basis once a day for 3 days: to one group of piglets – at a dose of 0.5 g with porridge, to another group – at a dose of 1.0 g with a liquid feed, to the third group – at a dose of 0.5 g with a dry feed.

The animals were handled in accordance with European Convention ETS No. 123.

RESULTS AND DISCUSSION

Kutikulin was administered to newborn and older calves affected with mild dyspepsia resulting from various alimentary causes.

The data presented in Table 1 show that the disease duration in newborn calves in both groups averaged 2.9 days, with recovery rates being approximately the same (96.6 and 96.9%). The use of Kutikulin in older calves allowed to reduce the treatment duration by almost a day, to increase the recovery rate by 4.8% and to decrease the number of deaths by 1.6 times.

Kutikulin was tested for its preventive effectiveness in weaned piglets. Test and control group animals were clinically observed from the moment of weaning until the age of 60 days. During that period, the number of diseased piglets demonstrating the signs of diarrhea and that of piglets, which died from gastroenteritis, were recorded.

The test results presented in Table 2 show that, among 250 weaned piglets of group 1 (test) that received Kutikulin with porridge, 6 piglets (2.4%) became diseased and one piglet (0.4%) died, whereas, among 220 weaned piglets that did not receive the product, 16 piglets (7.3%) became diseased and 2 piglets (0.9%) died. Among 130 piglets of group 3 (test) that received Kutikulin with a liquid feed, 7 piglets (5.4%) became diseased, no deaths occurred. Among 138 piglets of group 4 (control), 62 piglets (44.9%) became diseased, 7 piglets (5.1%) died. Among 576 weaned piglets of group 5 (test) that received the product with a dry feed, 138 piglets (24.0%) became diseased and 37 piglets (6.4%) died. In group 6 (control) comprising 580 piglets, 251 piglets (43.3%) became diseased and 46 piglets (7.9%) died.

During the use of Kutikulin, piglet morbidity in groups 1, 3 and 5 (test groups) decreased, as compared with groups 2, 4 and 6 (control ones), by 2.7, 8.9 and 1.8 times, respectively. Its preventive effectiveness was found to be the highest in group 3 (test) piglets that received the product at a dose of 1.0 g with a liquid feed. The piglets that received Kutikulin demonstrated a shorter disease duration and less pronounced clinical symptoms.

At present, there is no unified view on the mechanisms of tissue-based product action. Biogenic stimulants have effect on the body as a whole. This explains a wide span of their impact. Our test results are consistent with the findings of some researchers regarding the improvement of general responsiveness and functional state of the reticuloendothelial system, activation of gastric gland functioning, intensification of immunobiological activity, stimulation of regenerative processes, gas exchange, hematopoiesis and other vital body functions in response to tissue therapy and, in particular, administration of Kutikulin [21–24].

The use of such substances contributes to better growth and development of young stock, increased weight gains, enhanced natural resistance of the body, improved metabolism and reproductive performance in animals. Livestock and poultry morbidity and mortality rates decrease [25, 26].

CONCLUSION

Thus, Kutikulin has a therapeutic and preventive effect against gastrointestinal disorders in calves and piglets, it is easy to prepare and administer and can therefore be recommended for a wide practical application. Kutikulin has a stimulating and normalizing effect in animals with digestive tract malfunction, as well as in piglets during the period of weaning and adaptation to a new milk free diet, helps to decrease animal morbidity and mortality.

REFERENCES

1. Mavlyutova A. G., Sidorova K. A. Otsenka sostoyaniya organizma porosyat pri ispol'zovanii biostimulyatorov = Body condition assessment in biostimulant-treated piglets. *Aktual'nye voprosy nauki i hozjajstva: novye vyzovy i reshenija: materialy LI Mezhdunarodnoj studencheskoj nauchno-prakticheskoj konferencii = Topical issues of science and economy: new challenges and solutions: proceedings of the LI International Student Research-to-Practice Conference (16 March 2017)*. Tyumen: Northern Trans-Ural SAU; 2017; 196–198. eLIBRARY ID: 30096732. (in Russ.)

2. Shikunova I. A. Sovremennyj mehanizm immunomoduljacii = Contemporary immunomodulation mechanism. *VetPharma*. 2012; 1–2 (6–7): 30–33. eLIBRARY ID: 20504287. (in Russ.)

3. Yakhin O. I., Lubyanov A. A., Yakhin I. A. Regarding the challenge of biostimulants legal and regulatory framework. *Agricultural Chemistry*. 2020; 9: 87–96. DOI: 10.31857/S0002188120090124. (in Russ.)

4. Makarova V. N., Simanova I. N., Badeeva O. B., Korukina M. V. Epizootological aspects of acute gastrointestinal diseases of newborn calves in the farms of the Vologda region. *Veterinaria i kormlenie*. 2019; 2: 26–27. DOI: 10.30917/ATT-VK-1814-9588-2019-2-9. (in Russ.)

5. Kotcumbas I. Y., Zhyla M. I., Shkodiak N. V., Pyatnychko O. M. The control methods of biological activity of modern veterinary immunomodulators. *Scientific Messenger of Lviv National University of Veterinary Medicine and Biotechnologies*. 2014; 16 (2-2): 165–174. eLIBRARY ID: 25480853. (in Ukrainian)

6. Fedota N. V. Gematologicheskie pokazateli i matematicheskoe modelirovanie bioritmov prirosta zhivoj massy u ovec pri dejstvii biostimuljatorov = Hematological parameters and mathematical modeling of live weight gain biorhythms in biostimulant-treated sheep: author's abstract of Candidate of Science (Biology) thesis. Stavropol; 1998. 24 p. eLIBRARY ID: 30233652. (in Russ.)

7. Ostrickova E. E. Dynamics morphological composition of the blood repair pigs at used probiotics and biostimulators. *Veterinarnaya patologiya*. 2012; 2: 67–69. eLIBRARY ID: 17878417. (in Russ.)

8. Volynkina M. G., Ivanova I. E. Ispol'zovanie biostimuljatora pri vyrashhivanii porosjat = Biostimulant use in piglet rearing. *The Electronic Scientific Journal*. 2017; 1-1 (16): 16–18. eLIBRARY ID: 28773239. (in Russ.)

9. Krasnova O. A., Lazareva K. V. Growth and development of black-pied bull calves when using a biostimulator. *Proceedings of Gorsky State Agrarian University*. 2021; 58 (3): 83–87. eLIBRARY ID: 46596796. (in Russ.)

10. Daricheva N. N., Ermolaev V. A. Tissue therapy in veterinary medicine. Ulyanovsk: Ulyanovsk SAA; 2011. 168 p. eLIBRARY ID: 19517178. (in Russ.)

11. Pushkarev I. A., Kureninova T. V., Shanshin N. V., Belyaeva N. Yu. The effect of different doses of tissue bio-stimulant on blood serum protein composition in lactating cows. *Bulletin of KrasSAU*. 2020; 12: 96–101. DOI: 10.36718/1819-4036-2020-12-96-101. (in Russ.)

12. Kureninova T. V., Pushkarev I. A., Silivirova T. L., Shanshin N. V., Mironova A. V., Pushkarev V. A. The influence of a new tissue biostimulant on cow milk production level. *Vestnik Altaiskogo SAU*. 2019; 7 (177): 102–109. eLIBRARY ID: 41188987. (in Russ.)

13. Kudasheva A. V., Rogachev B. G., Seitov M. S., Provotorov N. K. Methods of treatment and prophylaxis of gastric-intestinal diseases in calves. *Izvestia Orenburg State Agrarian University*. 2009; 4 (24): 162–163. eLIBRARY ID: 12990643. (in Russ.)

14. Malkova N. N., Ostyakova M. E., Golaydo N. S., Irkhina V. K., Shcherbinina S. A., Gavrilov Yu. A., Gavrilova G. A. Alimentary-functional diarrhea of calves and its therapy. *Agrarian Bulletin of the Urals*. 2019; 181 (2):

29–35. DOI: 10.32417/article_5cb0aea9e2a880.36987343. (in Russ.)

15. Dmitriev A. F., Agarkov A. V. Development of a correction method for the immunobiological status of newborn animals. *Proceedings of Gorsky State Agrarian University*. 2017; 54 (3): 102–108. eLIBRARY ID: 30031121. (in Russ.)

16. Frolova M., Slozhenkina M., Mosolov A. Micro seaweeds – a natural biogrowth factor. *Animal Husbandry of Russia*. 2021; 9: 55–56. DOI: 10.25701/ZZR.2021.31.46.010. (in Russ.)

17. Makarova V. N., Koryukina M. V., Badeeva O. B., Simanova I. N. The use of immunostimulants for the animal diseases prevention. *AGRITECH-IV-2020. IOP Conf. Ser.: Earth Environ. Sci*. 2021; 677:052103. DOI: 10.1088/1755-1315/677/5/052103.

18. Ovsyannikov A. P., Sunagatullin F. A., Khayrullin D. D. The impact of a biological pacemaker according to V. P. Filatov, with the addition of microelements on biochemical composition of blood of calves. *Scientific Notes Kazan Bauman State Academy of Veterinary*. 2017; 231 (3): 112–114. eLIBRARY ID: 30016066. (in Russ.)

19. Bezborodov N., Bondarenko E. Primenenie immunomoduljatora timogena dlja lechenija teljat s funkcional'noj dispepsiej = The use of the immunomodulator Thymogen for treatment of calves with functional dyspepsia. *Dairy and Beef Cattle Farming*. 2009; 2: 24–26. eLIBRARY ID: 12913577. (in Russ.)

20. Petrova O. G., Alekseev A. D. The use of plant-tissue preparation for the treatment and prevention of gastrointestinal infections in calves in the Ural Region. *Scientific-methodological electronic journal "Concept"*. 2014; 20: 1046–1050. Available at: http://e-koncept.ru/2014/54473.htm. (in Russ.)

21. Kalashnik I. A. Tissue therapy in veterinary medicine. Moscow: Sel'khozgiz; 1960. 103 p. (in Russ.)

22. Fedota N. V., Sannikov M. Ju. Biorhythms of the growth in young rams under feeding preparation obtained from brain tissues. *Problems of Productive Animal Biology*. 2012; 1: 26–31. eLIBRARY ID: 17588050. (in Russ.)

23. Danilova L. G., Nekrasova I. I. Vlijanie dlitel'noj adaptacii k uslovijam juga Rossii na jekster'ernye i fiziologicheskie pokazateli pastush'ih sobak porody avstralijskij kelpi = The effect of a long term adaptation to southern Russia conditions on the exterior and physiological characteristics of Australian Kelpie sheepdogs. *Scientific Notes Kazan Bauman State Academy of Veterinary*. 2009; 196: 107–113. eLIBRARY ID: 22290710. (in Russ.)

24. Fedota N. V. Technology of activity increasing and prolongation of storage term of tissue preparations. *The Agrarian Scientific Journal*. 2012; 6: 42–43. eLIBRARY ID: 17786470. (in Russ.)

25. Linnik A. A., Alekseeva S. A., Kuznetsov O. Y. Efficiency of application of the new biostimulator in poultry farming. *Bulletin of the Kursk State Agricultural Academy*. 2015; 7: 151–153. eLIBRARY ID: 28899344. (in Russ.)

26. Ryzhkova G. F., Aleksandrova E. V., Evglevskij A. A., Evglevskaja E. P. Vlijanie biostimuljatorov na osnove jantarnoj kisloty na morfologicheskie i biohimicheskie pokazateli krovi cypljat-brojlerov = The effect of succinic acid-based biostimulants on the morphological and biochemical blood profile of broiler chickens. *Bulletin of the Kursk State Agricultural Academy*. 2011; 5: 71–73. eLIBRARY ID: 17704182. (in Russ.)

Received 24.12.2021
Revised 07.02.2022
Accepted 21.02.2022

INFORMATION ABOUT THE AUTHORS / ИНФОРМАЦИЯ ОБ АВТОРАХ

Marina V. Koryukina, Researcher, Vologda Branch of the FSC VIEV, Vologda, Russia.

Vera N. Makarova, Candidate of Science (Veterinary Medicine), Senior Researcher, Vologda Branch of the FSC VIEV, Vologda, Russia.

Oksana B. Badeeva, Senior Researcher, Vologda Branch of the FSC VIEV, Vologda, Russia.

Irina N. Simanova, Post-Graduate Student, Head of Vologda Branch of the FSC VIEV, Vologda, Russia.

Корюкина Марина Вениаминовна, научный сотрудник Вологодского филиала ФГБНУ ФНЦ ВИЭВ РАН, г. Вологда, Россия.

Макарова Вера Николаевна, кандидат ветеринарных наук, старший научный сотрудник Вологодского филиала ФГБНУ ФНЦ ВИЭВ РАН, г. Вологда, Россия.

Бадеева Оксана Борисовна, старший научный сотрудник Вологодского филиала ФГБНУ ФНЦ ВИЭВ РАН, г. Вологда, Россия.

Симанова Ирина Николаевна, соискатель, руководитель Вологодского филиала ФГБНУ ФНЦ ВИЭВ РАН, г. Вологда, Россия.