Chapter 19

INCREASING THE EFFICIENCY OF BEEF PRODUCTION THROUGH THE USE OF DRUGS OF MICROBIOLOGICAL ORIGIN IN DIETS

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INTRODUCTION

The world leader in beef production is the USA, and the leader in terms of the volume of its natural exports and the value equivalent in Australia. Beef production in Ukraine is significantly different from that in the world market. First of all, the reduction of the livestock population is associated with problems of an economic nature, in particular, due to the decrease in the profitability of its cultivation and the intensive growth of exports[1]. However, the relatively low purchasing power of the population has created a demand for cheap imported meat raw materials on the Ukrainian market[2].

Nevertheless, recently, the agro-industrial business of Ukraine is beginning to recover. Due to the owners' perseverance, the amount of meat raw materials in their production is increasing. Considerable attention is paid to the development of meat cattle breeding, in particular in the regions that are traditionally engaged in this[3].

However, producing high-quality beef products is determined by certain animal husbandry conditions, such as raising healthy young animals, ensuring full-fledged balanced feeding, and proper housing conditions. After all, young animals are the basis for the development of animal husbandry as a whole, and providing the population with veal, which in terms of raw material quality and valuable properties is an order of magnitude higher than

[1] http://uprom.info/. Національний промисловий портал. 8 листопада 2017. Архів оригіналу за 15 січня 2018.

[2] http://agravery.com/. Agravery. 7 серпня 2018.

[3] Угнівенко А. М. Шляхи вирішення проблеми виробництва яловичини в Україні (стан питання) [Електронний ресурс]. Режим доступу : http://www. irbis-nbuv.gov.ua/ (дата звернення: 19.10.2015 р.).

pork and chicken[4]. However, animals' natural resistance to various diseases decreases due to the lack of fodder and the unsatisfactory veterinary and sanitary conditions of livestock premises. As a result, dysbacteriosis and immunodeficiency states develop, the percentage of morbidity increases, productivity decreases, and animal mortality increases.

Over the years, antibiotics, as antimicrobials, have played a vital role in preventing gastrointestinal diseases and have been used as growth promoters in farm animals. The use of therapeutic antimicrobial drugs leads to a temporary delay in the development of diverse microflora of the gastrointestinal tract of ruminants, which can negatively affect their health due to an increase in a large number of genes associated with resistance to cationic antimicrobial peptides and beta-lactams. Currently, this has become an acute problem of animal husbandry, as the resistance of bacteria to antibiotics has increased, and drug residues are detected in food products. As a result, the use of antibiotics in animal husbandry has significantly decreased. In addition, Sweden banned the use of antibiotics in animal husbandry as early as 1986, and the European Union banned them as part of growth stimulants in young animals in 2006[5].

One of the main problems of animal husbandry, including meat, is obtaining and raising full-fledged, healthy young animals with good potential for growth and development. As you know, in the first weeks of life, newborn calves have imperfect immune protection mechanisms, which causes a high percentage of mortality among young calves from gastrointestinal diseases. In addition, such factors as violations of the feeding regime of cows during the period of deep calving, unsatisfactory conditions of keeping and feeding calves immediately after birth, stress, and other equally essential reasons led to significant economic losses, which affected the condition of many farms[6].

One of the ways to solve the problem of livestock preservation and prevention of gastrointestinal diseases in young calves could be using probiotic drugs that can activate and normalize ruminal digestion and improve metabolism, the result of which is the acceleration of their growth and development.

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[4] Козирь В. С. М’ясна продуктивність бугайців різних порід. Сучасне тваринництво. URL: http://agro-business.com.ua/agro/suchasne-tvarynnytstvo/item/8117-miasna-produktyvnist-buhaitsiv-riznykh-porid.html (дата звернення 4 червня 2019.

[5] Петрова О. І. Аналіз небезпечних чинників при виробництві яловичини. *Науково-інформаційний вісник біолого-технологічного факультету.* Херсон : ХДАУ, ВЦ «Колос», 2017. Вип. 7. С. 105–108.

[6] Механізми адаптації тварин південної м’ясної породи великої рогатої худоби до екстремальних умов степової зони України / Ю. В. Вдовиченко та ін. *Науковий вісник «Асканія-Нова»*. 2013. С. 132–141.

The use of probiotic preparations for calves during the milk growing period has not yet been sufficiently studied; there is no accurate data on scientifically based doses and calculations of body weight gains of calves with the effectiveness of their use.

That is why the research aimed at clarifying the influence of different doses of probiotics *Bacillus Subtilis* and *Lactobacillus spp.* on the immunophysiological state of dairy calves and their growth and development indicators are relevant.

1. Assessment of factors affecting the adaptive performance of young Volyn beef breed during critical periods of maintenance

The natural and climatic conditions of Ukraine are quite favorable for the large-scale development of agriculture. The Volyn region is one of the most adapted regions of Ukraine for effective agriculture, particularly cattle breeding. Here, in the zones of the Polish lowland and the Volyn highlands, farms specialize in animal husbandry, in particular meat and dairy cattle breeding, pig and poultry farming, as well as crop production: growing sugar beets, wheat, rye, barley, and vegetables[7].

The development of animal husbandry also largely depends on fodder production and its components, which are the main prerequisites for productive animal husbandry. Essential components are field production and rational use of forage of plant origin, as well as natural fodder areas: hayfields and pastures[8].

In the structure of fodder production in the Volyn region, about 80% is occupied by straw, coarse, and juicy fodder, which can be most rationally used for feeding livestock of the meat and milk-meat productivity sector and on livestock complexes for fattening animals of various sectors on an industrial basis.

Pastures play an essential role in cattle breeding. In their presence, meat cattle breeding has a significant advantage since the animals are kept on pastures for most of their productive time.

The breed of animals and their adaptation to specific conditions of existence are of great importance in adequately managing the economy. The Volyn meat breed is characterized by good adaptability to the climatic conditions of the Western region of Ukraine, well adapted to the diet with relatively low feed costs to achieve the desired growth, reflected in the

[7] О. В. Метілка, Л. Ю. Івевакова. Волинська область [Архівовано 3 червня 2016 у Wayback Machine.] // Енциклопедія сучасної України / ред. кол.: І. М. Дзюба [та ін.] ; НАН України, НТШ. К. : Інститут енциклопедичних досліджень НАН України, 2001–2023. ISBN 966-02-2074-X.

[8] Норми, орієнтовні раціони та практичні поради з годівлі великої рогатої худоби : [посібник] ; за ред. І. І. Ібатулліна, В. І. Костенка. Житомир : ПП «Рута», 2013. 516 с.

maximum profitability of production. Cows of this breed have good maternal qualities, high milk yield, and reproductive capacity[9].

Volyn beef is the second breed of cattle bred in Ukraine, and it ranks first among domestic beef breeds in terms of number of livestock. The need for its creation is due to a number of socio-economic, food and ecological factors, as well as the specifics of the Polissia and Carpathian regions of Ukraine, where other meat breeds were poorly acclimatized and did not sufficiently use natural and cultural pastures[10].

However, the solution to the task of intensification of meat cattle breeding at the expense of purebred breeding of existing breeds is complicated by the limited possibilities of stocking marketable meat herds with highly productive young animals, in particular, those that meet the requirements of beef production technology on an industrial basis. Furthermore, the breeding of meat cattle at the expense of adequately organized extended reproduction in breeding herds of meat breeds is a long-term process.

The specific weight of specialized meat breeds is insignificant (only 0.2%), and the main amount of beef meat is obtained from dairy and milk-meat cattle, which also have high potential properties. When intensively reared under conditions of industrial technology, dairy bulls reach a body weight of 400 kg by 14 months of age, and dairy and meat bulls – 450 kg, with a cost of 6.4–7.5 feed units per 1 kg of growth[11].

For beef production on an industrial basis, it is advisable to create specialized feedlots, where the primary attention will be paid to keeping animals according to age and purpose. Calves will be fattened with well-balanced feeding rations and all the necessary conditions for their intensive growth and development. Despite the rich scientific and practical experience of Ukraine and the world community, a clear answer to the optimal options for selecting animal breeds at these sites has not been received. This issue is especially relevant in the prospective plans for further management of the meat and livestock industry in the Volyn region.

At present, obtaining and growing full-fledged healthy calves remains one of the main problems of animal husbandry. Compared to adult cattle,

[9] Бабік Н. П., Федорович Є. І., Гурський І. М. Вікові особливості природної резистентності молодняку волинської м'ясної породи в умовах Львівщини. *Вісник Сумського національного аграрного університету. Науково-методичний журнал. Серія «Тваринництво»*. 2014. Вип. 2/2 (25). С. 21–26.

[10] Волинська м'ясна порода великої рогатої худоби / В. П. Буркат, В. П. Лукаш // Енциклопедія Сучасної України [Електронний ресурс] / редкол. : І. М. Дзюба, А. І. Жуковський, М. Г. Железняк [та ін.] ; НАН України, НТШ. К. : Інститут енциклопедичних досліджень НАН України, 2006. Режим доступу : https://esu.com.ua/article-27568

[11] Петрова О. І, Попсуй. В. В. Особливості забійної продуктивності м'ясної худоби у залежності від генетичної належності. *Зб. наукових праць Вінницького національного аграрного університету*, Вінниця, 2018. Вип. 1(76). С. 132–136.

newborn calves have their own physiological and biochemical features of the body, and they relate to the structural, metabolic, and functional activity of various organs and systems. After birth, a complex adjustment of the young growing organism to the changing conditions of the external environment takes place[12].

It is also known about the peculiarities of calves' digestion during the milk feeding period. What is unique about this period is that the rumen in calves is almost non-functioning, and the rennet serves as the stomach. The only food for calves of this age is milk, which passes through the esophageal groove, bypassing the rumen, into the rennet. In addition, the main stimulus for survival is the act of sucking[13].

At this time, the gastrointestinal tract of newborn calves is not yet inhabited by microflora. The first contact with microorganisms in calves occurs during passage through the birth canal of the mother[14]. Microorganisms inhabit the gastrointestinal tract of calves: lacto- and bifidobacteria, enterococci, *Escherichia coli*, staphylococci, etc[15, 16, 17 ,18].

The critical point is that, regardless of the time of birth, the calf should drink the first portion of colostrum within an hour, that is, receive its passive immunity associated with protective substances (antibodies). Colostrum provides saturation of the body with γ-globulins, which are carriers of antibodies that can resist pathogenic microorganisms[19].

From the second week of life, plant fodder (hay) is added to the dairy feed to stimulate the development of their foreskin. Eating fiber, the prestomachs of calves begin to populate with protozoa and microorganisms, while not only the type of feed changes, but also the animal's digestion. At

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[12] Костенко В. Особливості вирощування телят: профілакторний період URL: http:/www.agrobisiness.com.ua/suchasne tvarynnytstvo/1400.html. (дата звернення 12 лютого 2013).

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[15] Fabregas F., Genis S., Bach A., Aris A. Ex vivo and in vitro effects of Lactobacillus rhamnosus in the control of gastrointestinal infections in calves. *J. Dairy Sci*. 2013. Vol. 96 (E-suppl. 1), 57. (Abstr.).

[16] Bifidobacteria from the gastrointestinal tract of animals: differences and similarities / V. Bunesova et al. *Benef Microbes*. 2014. Vol. 5. № 4. P. 377–388.

[17] Karamzadeh-Dehaghani A., Towhidi A., Zhandi M. et al. Combined effect of probiotics and specific immunoglobulin Y directed against Escherichia coli on growth performance, diarrhea incidence, and immune system in calves. *Animal.* 2021. V. 15. Is 2. P. 100−124. doi: 10.1016/j.animal.2020.100124.

[18] Lu Q., Niu J., Wu Y. et al. Effects of Saccharomyces cerevisiae var. boulardii on growth, incidence of diarrhea, serum immunoglobulins, and rectal microbiota of suckling dairy calves. *Livest Sci*. 2022. V. 258. P. 104875. doi: 10.1016/j.livsci.2022.104875.

[19] Ahmann J., Steinhoff-Wagner J., Büscher W. Determining Immunoglobulin Content of Bovine Colostrum and Factors Affecting the Outcome: A Review. *Animals (Basel).* 2021. V. 11. Is. 12. P. 3587. doi: 10.3390/ani11123587.

this time, the intestinal type of digestion characteristic of dairy calves changes to the gastrointestinal one, characteristic of adult animals[20]. From the second to the third week of life, calves begin to be fed concentrated feed (oat groats, wheat bran, flax meal, etc.). The entire functioning of the rumen begins approximately before the 60th day of the life of the calves.

Feeding rations for calves for decades are balanced in terms of nutrients following their age, the way of keeping, and the purpose of the animal. Correctly balanced feeding and the use of biologically active substances (BAS) allow for regulation the processes of digestion and metabolism to increase resistance and resistance to the influence of various stress loads, which ensures the realization of genetically determined livestock productivity[21].

When raising calves, considerable attention is paid to studying the state of the immune system, which is an essential component of the physiological status[22, 23].

Physiological blood regeneration also takes place during the lactation period. Blood is considered a direct reflection of all processes and the changes occurring in the body. The hematopoietic system of young animals is subject to changes in biochemical processes under the influence of physiological factors. Placental circulation is replaced by pulmonary circulation; the volume and composition of circulating blood changes due to the rapid growth of animals[24].

Depending on the age of animals, the number of formed blood elements and their functional activity changes. The cellular composition of blood is supported by the relationship between blood and blood-forming organs and is regulated by the humoral link of the nervous system[25].

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[20] Янович В. Г. Симбіоз жуйних із мікроорганізмами передшлунків. *Вісник аграрної науки*. 2002. № 7. С. 41–44.

[21] Розробка і виробництво кормів і кормових добавок для сільськогосподарських тварин. (Рекомендований раціон годівлі телят від народження до 3-х місяців) «АНКОРЕС-Україна» URL: https:// www.ankores.com.ua/ua/publications/osoblivosti-godivli-telyat-vid-narodzhennya- do-6-ti-misyatciv/ (дата звернення 2019).

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[24] Іонов І. А., Комісова Т. Є., Слюсарєв В. Ф., Шаповалов С. О. Фізіологія крові та внутрішнього середовища: методичні рекомендації. Х. : ЧП Петров В. В., 2017. 48 с.

[25] Фізіолого-біохімічні показники крові телиць української чорно-рябої молочної породи різних екстер'єрних типів в окремі вікові періоди / М. С. Бердичевський та ін. *Науково-технічний бюлетень інституту біології тварин*. Львів, 2008. Вип. 9. № 3. С. 280.

Body weight is also an important indicator for calves, which is related to feeding processes and is reflected in their growth and development. It is typical for calves to double their body weight during a certain period of life, on the 47th day. During this period, assimilation processes dominate over dissimilation in a young growing body, which is accompanied by intensive deposition of fat[26, 27].

Many young growing organisms' functions create a complex biological complex closely related to intestinal microflora. The average activity of many animal systems and organs largely depends on the species composition and interspecies ratio of microorganisms inhabiting the animal body from the first days of birth. In conditions of intensive animal husbandry, this is not always possible; therefore, the microflora should be supplemented with probiotic feed additives, which allows you to preserve livestock, achieve high body weight gains, and expect increased productivity.

A change in the normal intestinal microflora, its composition, number, and localization of certain types of microorganisms leads to pathology on the part of the animal's gastrointestinal tract and causes a disease – dysbacteriosis. This disease is inextricably linked with the concept of diarrhea, which is characterized by digestive disorders[28]. Thus, preventing diseases with diarrhea syndrome should be directly related to the fight against dysbacteriosis.

Based on the fact that bifidobacteria dominate among the prominent representatives of the normal intestinal microflora of calves, scientists concluded that they are the criterion for assessing the state of the digestive organs. Bifidobacteria can stop the reproduction of other bacteria belonging to the group of pathogenic or opportunistic pathogens. Second, in the normal microbiocenosis of the intestines of animals, lactic acid bacteria are present, namely from the genus Lactobacterium. Lactic acid bacteria can synthesize various antimicrobial substances that show their effect concerning putrefactive, pathogenic, opportunistic microflora[29].

A versatile pharmacological effect characterizes probiotics, and their positive impact is due to participation in the processes of metabolism and

[26] Бурлака В. А., Борщенко В. В., Кривий М. М. Біологія продуктивності сільськогосподарських тварин: Курс лекцій. Житомир : Вид-во ЖДУ імені І. Франка, 2012. 191 с.

[27] Яремко О. В., Пеленьо Р. А. Інтенсивність росту телят української чорно-рябої молочної породи у молозивний і молочний періоди за згодовування їм піридоксину гідрохлориду. *Науковий вісник Львівського національного університету ветеринарної медицини та біотехнологій імені С. З. Гжицького.* 2019. Т. 21. № 90. С. 108–112.

[28] Fomenky B. E., Do D. N. Talbot G., et al. Direct-fed microbial supplementation influences the bacteria community composition of the gastrointestinal tract of pre- and post-weaned calves. *Sci Rep.* 2018. V. 8. Is. 1. P. 14147. doi: 10.1038/s41598-018-32375-5.

[29] Bifidobacteria from the gastrointestinal tract of animals: differences and similarities / V. Bunesova et al. *Benef Microbes*. 2014. Vol. 5. № 4. P. 377–388.

resistance. Probiotics are recognized in world science and practice as a means of non-specific prevention of gastrointestinal diseases[30].

At the same time, enzymatic feed additives improve the gastrointestinal tract's microflora, promoting feed assimilation and digestibility, neutralizing toxins, and having a direct antibacterial effect, stimulating immunity, thereby increasing the level of immunoglobulin content[31].

Several dozen probiotic preparations based on spore-forming bacteria of the genus *Bacillus*, known for a long time in human history, are used in veterinary medicine. They are isolated from various biotopes, including the body and tissues of warm-blooded animals, insects, and plants. Probiotics can resist many pathogenic and opportunistic microorganisms and effectively and quickly prevent dysbacteriosis in animals of various etiologies. Live cultures of spore-forming aerobic bacteria from the genus *Bacillus* should be considered ecologically clean and promising for use in animal husbandry[32].

Therefore, when the microflora of the gastrointestinal tract of young animals is weakly protected from the action of pathogenic and opportunistic microorganisms, the additional introduction of probiotics to their diet significantly improves the general condition of animals and has a preventive effect against dysbacteriosis of various origins. In addition, probiotics produce water-soluble B vitamins that can enhance the metabolism of nutrients in the gut, and results include improved body weight and reduced incidence of diarrhea in calves[33].

2. Preparation of calves of the Volyn beef breed for research with the aim of additional correction of their diets with probiotics

The research was carried out in the conditions of the Ltd. "Zorya" of the Kovel district, Volyn region, on calves of the Volyn beef breed from the 5th to the 60th day after birth.

[30] Cull C., Singu V.K., Cull B.J. et al. Efficacy of Lactobacillus animalis and Propionibacterium freudenreichii-Based Feed Additives in Reducing Salmonella-Associated Health and Performance Effects in Commercial Beef Calves. *Antibiotics (Basel).* 2022. V. 11. Is. 10. P. 1328. doi: 10.3390/antibiotics11101328.

[31] Graham C., Simmons N. L. Functional organisation of the bovine rumen epithelium. *Am. J. Physiol. Regul. Integr. Comp. Physiol.* 2005. Vol. 288. January. R173–R181. DOI: 10.1152/ajpregu.00425.2004.

[32] Dar A. H., Singh S. K., Rahman J. U. et al. The effects of probiotic Lactobacillus acidophilus and/or prebiotic mannan oligosaccharides on growth performance, nutrient utilization, blood metabolites, faecal bacteria, and economics of crossbred calves. *Iran J Vet Res.* 2022. V. 23. Is. 4. P. 322−330. doi: 10.22099/IJVR.2022.42992.6259.

[33] Калачнюк Г., Калачнюк Л. Аспект симбіозу в розробці біотехнологічних основ підвищення продуктивності тварин: ISSN 0206-5657. *Вісник Львівського університету. Серія : Біологічна*. 2015. Вип. 70. С. 3–17.

When conducting experimental studies, the "General Ethical Principles of Animal Experiments" approved at the National Congress on Bioethics (Kyiv, 2006) were followed[34] and consistent with the provisions of the "European Convention for the Protection of Vertebrate Animals" used for experimental and other scientific purposes (Strasbourg, 1986)[35].

To carry out studies based on the principle of paired analogs, taking into account the breed, age, body weight, and clinical and physiological state, three groups of calves (control and two experimental) of 8 animals each were formed. Calves of the control group were fed only the feed of the main ration (MR). The calves of the experimental groups received the basic ration (MR) and additional probiotic preparations. The 1st experimental group was MR and the addition of *Bacillus Subtilis*; the second was MR and the addition of *Lactobacillus spp*. The calves of the experimental groups received probiotic preparations by drinking warm water, first through a heat pump, and were gradually accustomed to drinking from a regular drinker. The daily dose of probiotics was drunk in two doses in the morning and evening according to the following scheme: from 5 to 30 days – at the rate of 15 g per head/day; from 31 to 60 days – 20 g per head/day.

The research material was heparin-stabilized venous blood and blood serum of experimental calves. Blood samples were collected once on the fifth, 30th, and 60th days after the birth of the calves. At the beginning of experimental studies, blood was taken from the jugular vein in tubes with 3-4 ml of anticoagulant in the morning two hours before feeding. Samples were stored at a temperature of 4 C, taking into account the rules of veterinary septic and antiseptics.

The morphological composition of blood was determined on a hematological analyzer. Biochemical blood analysis was performed on a Stat Fax digital biochemical analyzer.

To determine the level of natural resistance of animals, the following were determined: bactericidal activity of blood serum (BABS) by the photonephelometric method in a modification using the test culture of Escherichia coli; blood serum lysozyme activity (BSLA) by the photoelectrocolorimetric method using the Micrococcus lysodeikticus test culture; phagocytic activity of blood serum (FABS) using a test culture of Staphylococcus albus and complementary activity of blood serum (CABS).

[34] Закон України № 3447-IV «Про захист тварин від жорстокого поводження» / *Відомості Верховної Ради України (ВВР)*. 2006. № 27. С. 230. (Бібліотека офіційних видань).

[35] European convention for the protection of vertebrate animals used for experimental and other scientific purposes. Council of Europe. Strasbourg, 1986. 53 p.

Determination of the concentration of immunoglobulins of classes G, M, and A was carried out by discrete precipitation.

To study the growth dynamics of young cattle at the same morning hours before watering and feeding animals at the age of 5–30- and 60 days, individual weighing was carried out according to generally accepted methods. Calves' body weight was calculated between final and initial weighing[36].

Based on the data obtained from weighing, the body's absolute and average daily weight gain was calculated.

Absolute growth for individual age periods was calculated according to the formula:

$$A = W_t - W_0,$$

where A – absolute increase;
W_0 – value of the parameter at the beginning of the period;
W_t – value of the parameter at the end of the period.

Average daily weight gain was determined by the formula:

$$C = A : t, \text{ or } C = (W_t - W_0) : t,$$

where C – average daily increase;
A – growth over a period of time;
t – the time during which the average daily growth is determined.

Observation and clinical examination of experimental calves were done daily to detect morbidity and preserve the herd.

The economic effectiveness of drinking probiotics to calves in the early stages of postnatal ontogenesis was calculated based on the actual costs of the drug for conducting research and was calculated based on methodological recommendations[37].

Statistical processing of the received digital material was carried out using Microsoft Excel for Windows software. Arithmetic mean (M), its error (m), and probability level ($p<0.05$*, $p<0.01$**, and $p<0.001$***) were determined by the Student-Fisher test (t).

2.1. Morphological and biochemical parameters of the blood of calves of the Volyn beef breed when probiotics are used

The number of erythrocytes in animals of the control group was $4.85\pm0.16\times10^{12}$/l; in the experimental groups, it was at the level from $5.12\pm0.18\times10^{12}$/l to $5.32\pm0.38\times10^{12}$/l. At the end of the experiment, erythrocyte levels were significantly higher in all groups of calves receiving

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probiotics than in the control group. The maximum content of this indicator was higher at 1.13; 1.15; 1.09 times (by 0.66×10^{12}/l; 0.76×10^{12}/l; 0.52×10^{12}/l) in 5-day-old animals; at 1.15; 1.13; 1.14 times (by 0.76×10^{12}/l; 0.66×10^{12}/l; 0.72×10^{12}/l) in 30-day-old animals and in 1.08; 1.08; 1.09 times (by 0.46×10^{12}/l; 0.48×10^{12}/l; 054×10^{12}/l) in 60-day-old animals, respectively.

The increase in the hemoglobin content in the blood of the calves of the experimental groups relative to the control and background level was: in 5-day-old calves – by 1.14 and 1.18 times (by 14.4 and 17.8 g/l); by 1.12 and 1.16 times (by 11.6 and 15.2 g/l); in 30-day-old animals; by 1.14 and 1.20 times (by 14.2 and 19.6 g/l) in 60-day-old animals, respectively.

When analyzing the content of leukocytes in the blood of animals, it can be stated that calves of all groups tended to increase the content of leukocytes, but they were within the physiological norm.

The background value of leukocytes in the blood of animals of the control group was $10.06\pm2.16\times10^9$/l, in the experimental groups it was at the level from $8.02\pm1.03\times10^9$/l to $9.92\pm1.55\times10^9$/ l.

Thus, in animals of the control group, the number of leukocytes compared to the background increased on the 5th day of the study – by 1.11 times (by 1.16×10^9/l), on the 30th day – by 1.17 times (by 1.78×10^9/l) and 1.23 times (by 1.90×10^9/l) for 60 days.

In the calves of the experimental groups, the index relative to the background value increased by 1.20 on the 5th day of the study; 1.21; 1.18 times (by 1.94×10^9/l; 1.9 × 109/l; 1.7×10^9/l); for 30 days – by 1.28; 1.32; 1.26; times (by 2.66×10^9/l; 2.96×10^9/l; 2.52×10^9/l), respectively.

During the study period, along with the increase in the content of erythrocytes, the hematocrit index tended to increase and reached the maximum level in the experimental groups, exceeding the background and control values: on the 5th day of the study – 1.05; 1.06 times (by 1.7; 2.2%) and in 1.02; 1.03 times (by 0.9; 1.2%); for 30 days – 1.07; 1.11 times (by 2.8; 4%) and in 1.03; 1.06 times (by 1.19; 2.19%), respectively.

The use of probiotics positively affected the biochemical parameters of the blood of calves. The results of the study of the protein spectrum of the blood showed that the background value of the total protein of the blood serum of calves ranged from 58.80±1.23 to 60.90±1.10 g/l.

The content of albumins in the blood serum reached a significant increase by the end of the experimental period. In the animals of the I and II experimental groups, the index of the albumin fraction exceeded that of the animals of the control group on the 5th day of the study – by 1.06 and 1.07 times (by 2.2 and 2. 5 g/l); on the 30th day – by 1.06 and 1.1 times (0.92 and 2.16 g/l), on the 60th day – by 1.03 and 1.04 (1.5 and 2.1 g /l) respectively.

The content of globulins in the blood serum of calves at the beginning of the experiment ranged from 28.74±1.05 to 29.56±0.90 g/l. During the research period, a tendency to increase this indicator was observed in calves of all groups.

The increase in blood serum globulins reached the maximum values in the calves of the I and II research groups, exceeding the background and control values: on the 5th day of the study – 1.13; 1.15 times (by 3.86; 4.36 g/l) and in 1.11; 1.13 times (by 3.15; 3.69 g/l); on the 30th day – at 1.21; 1.30 times (by 6.08; 8.9 g/l) and 1.19; 1.29 times (by 5.7; 8.56 g/l) for 60 days, respectively.

2.2. Indicators of natural resistance and immunological status of the blood of young Volyn meat breed when using probiotics

As is known, the main parameters of the natural (non-specific) resistance of the body of young cattle are lysozyme, bactericidal, phagocytic, and complementary activity of blood serum. The immunity of young cattle is formed precisely at the age of the first 60 days of life. Therefore, the age of calves chosen for the study (5th, 30th, and 60th day) reflects the mechanisms of formation of natural resistance and immune protection of a young growing organism.

Table 1

Indicators of non-specific natural resistance of the body of calves under the influence of probiotics (M±m, n=8)

Indicators of natural resistance	Calf age	Group of animals		
		Control	I Experimental	II Experimental
BABS, %	5	31,60±0,428	37,38±0,847**	35,84±0,567**
	30	33,88±0,487	36,83±0,456**	39.59±0,485***
	60	37,38±0,277	46,91±0,759***	43,61±0,501***
BSLA, %	5	10,49±0,214	12,25±0,256**	12,29±0,171**
	30	10,70±0,262	12,75±0,290**	13,09±0,505**
	60	11,95±0,112	14,16±0,203***	15,12±0,237***
FABS, %	5	31,30±0,473	35,86±0,383**	36,44±0,521**
	30	31,51±0,276	35,64±0,355***	36,37±0,518***
	60	31,98±0,241	37,66±0,353***	39,40±0,286***
CABS, %	5	21,56±0,171	27,05±0,528***	26,91±0,235***
	30	22,10±0,315	27,84±0,519***	27,59±0,313***
	60	22,84±0,210	30,28±0,726***	31,14±0,775***

Примітка: *-P<0,05; **-P<0,01; ***-P<0,001

The data in Table 1 indicate that with the age of the calves, the indicators of non-specific resistance increased and reached their maximum value by the 60th day. Thus, BABS in 60-day-old calves increased by 18.3% compared to 5-day-old calves; BSLA – increased by 13.9%; CABS – increased by 5.9%.

The non-specific resistance of the young organism depends on the blood serum's phagocytic activity. The value of this indicator in the body of calves, to some extent, also varied in the direction of growth depending on the use of the specified probiotic feed additive.

The results of the conducted studies showed that starting from the 5th day of life, a difference in the non-specific resistance of the animals of the control and experimental groups was noted. Thus, the level of BABS, as a complex indicator determined by the sum of the action of all antimicrobial components, was 18.3% ($P<0.01$) and 13.4% ($P<0.01$) higher in the II research group in the II research group group – by 13.9% ($P<0.01$) and 16.9% ($P<0.01$). Other indicators of natural resistance also increased: BSLA – by 16.8% ($P<0.01$) and 17.2% ($P<0.01$); FABS – by 14.6% ($P<0.01$) and 16.4% ($P<0.01$) and CABS – by 25.5% ($P<0.001$) and 24.8% ($P<0.001$).

At 30 days, an increase in non-specific resistance was also noted: under the influence of *Bacillus Subtilis*, BABS indicators were higher by 13.9% ($P<0.01$), under the influence of *Lactobacillus spp*. – 16.9% ($P<0.001$). Accordingly, BSLA – by 19.2% ($P<0.01$) and 22.3% ($P<0.01$); FABS – by 15.4% ($P<0.001$) and 14.4% ($P<0.001$); CABS – by 26.0% ($P<0.001$) and 24.8% ($P<0.001$).

At 60 days, changes in the indicators of non-specific blood resistance were also noted in the experimental groups of calves. In the 1st research group, the BABS indicator was higher by 25.5% ($P<0.001$), and in the 2nd group, by 16.7% ($P<0.001$).

The lysozyme activity of the blood serum of the calves of the experimental groups increased by 18.5% ($P<0.001$) and 27.2% ($P<0.001$). The stated BSLA activity of the research groups is explained by the active production of lysozyme by monocytes and macrophages and its release from neutrophil leukocyte granules.

The phagocytic activity of the humoral link of non-specific resistance of the body of the experimental calves was significantly higher compared to the control by 17.8% ($P<0.001$) and 23.2% ($P<0.001$).

It is also known that the complement activates the action of antibodies that protect the animal body from developing infectious and invasive diseases. This indicator in the blood serum of experimental groups of 60-day-old animals under the influence of probiotic supplements changed in the direction of growth by 32.6% ($P<0.001$) and 36.3% ($P<0.001$).

In ruminants, passive immunity is formed exclusively due to the consumption of colostrum since the placenta, in which the epithelium of the chorion is in direct contact with the tissues of the uterus, prevents the transfer of immunoglobulins from the mother to the fetus. The study of the protective functions of a young growing organism is essential, as is the quantitative determination of immunoglobulins in the blood serum of calves. The results of the study of the content of immunoglobulins in the blood serum of calves of the Volyn beef breed under the influence of probiotic supplements are shown in Table 2.

Table 2

The content of immunoglobulins in the blood of calves under the influence of probiotics (M±m, n=8)

Immuno-globulins	Calf age	Groups of animals		
		Control	I Experimental	II Experimental
Ig G,	5	9,44±0,218	11,89±0,278**	12,64±0,368**
	30	15,16±0,215	22,56±0,474***	23,13±0,614***
Ig M	5	2,59±0,063	3,68±0,194**	3,77±0,098***
	30	3,62±0,061	4,66±0,168**	5,44±0,104***
Ig A	5	1,82±0,040	2,34±0,034***	2,32±0,025***
	30	2,54±0,041	3,13±0,018***	3,42±0,034***

Примітка: *-P<0,05; **-P<0,01; ***-P<0,001

According to our data, the concentration of Ig G in the blood of control calves increased by 75.9% from the 5th to the 30th day of life, which indicates the formation of colostral immunity. A significant increase in the level of this immunoglobulin was also noted in the blood serum of the experimental groups. On the 5th day of life, Ig G increased by 58.8% (P<0.001) in experimental group I and by 42.8% (P<0.01) in group II.

At the age of 30 days, Ig G increased by 36.1% (P<0.01) and 60.8% (P<0.001). Similar changes in animals were observed in the content of other immunoglobulins.

As the animals grew, the level of Ig M by 39.8% was observed. At the same time, there was a natural increase in the concentration of Ig M in the blood serum of experimental groups of animals depending on the use of the specified probiotic supplements. Thus, at the age of 5 days, the concentration of Ig M in the animals of the I experimental group increased by 42.1% (P<0.01), and in the II experimental group – by 45.6% (P<0.01).

The level of Ig M in the blood serum of 30-day-old calves of the II research group increased by 50.3% (P<0.001) and in the I research group – by 28.7% (P<0.01) compared to the control.

In our research, the level of Ig A in 30-day-old calves increased by 39.6% compared to 5-day-old calves. In the first experimental group at the age of 5 days, the concentration of Ig A increased by 28.6% (P<0.001), and in the II experimental group – by 27.5% (P<0.001). The corresponding picture was also on the 30th day: an increase in Ig A was noted by 23.2% (P<0.001) and 34.6% (P<0.001) in the I and II experimental groups, respectively.

The obtained results of the positive effect of probiotic supplements can be explained by the fact that probiotic strains and beneficial bacteria, such as acidophilic lactobacilli, begin to colonize the large intestine. This leads to a change in the population of beneficial microorganisms while suppressing the number of harmful bacteria. In addition, the production of volatile fatty acids by bacteria can increase energy use efficiency and change intestinal morphology.

Therefore, due to the increase in indicators of natural resistance and the body's immune system, calves that drank probiotic preparations did not have gastrointestinal disorders and lung diseases.

In addition, due to the improvement of the work of the digestive organs, especially the rumen, the calves of the experimental groups had more significant body weight gains.

2.3. Indicators of growth of young animals when using probiotics

As a result of the conducted scientific and economic experiment, it was established that the inclusion of probiotics *Bacillus Subtilis* and *Lactobacillus spp*. to the ratio of calves during the dairy period of growth had a positive effect on indicators of body weight, absolute growth, and average daily growth in both experimental groups, as evidenced by the data in Table 3.

As seen from the data in Table 3, at the beginning of the experiment, the indicators of the average body weight of the calves of both the control and experimental groups were almost the same. At the end of the experiment, these indicators were better in the calves of the II research group.

However, absolute growth does not characterize the intensity of animal growth, as it does not reflect the relationship between the growing body weight of animals and their growth rate. With the same absolute daily gain of two bulls (1000 g), the intensity of their growth depends on body weight. It is expressed as a relative growth rate or a relative increase (this is the increase in the weight of animals before the start of the control period).

Table 3

Dynamics of growth indicators of young animals under the influence of probiotics (M±m, n=8)

Indicators	Group of animals		
	Control	I Experimental	II Experimental
Body weight at the beginning of the experiment, kg	44,4±1,08	44,1±1,25	44,8±1,13
Body weight at the end of the experiment, kg	143,4±1,06	152,6±1,44*	155,3±1,29*
Absolute growth, kg	99,0	107,8	111,2
Average daily increase, g	550,0	599,0	617,8

Примітка: *−P<0,05.

Thus, the best indicators of body weight and absolute and average daily gains were in the II research group of animals given Lactobacillus spp. Thus, the average daily gain of calves of the II experimental group was 617.8 g, which is 67.8 g more than the indicators in the control group. Similarly, this indicator was higher in the 1st experimental group and amounted to 599.0 g, 49.0 g higher than the control group.

The absolute increase was the highest in the II research group – 111.2 kg, 12.2 kg more than the control group. In the first experimental group, it was 107.8 kg, which was also higher than the control group by 8.8 kg.

During the experiment, the general condition of the animals was monitored: appetite, feed consumption, presence of diseases, and other signs characterizing the health of the animals were observed.

The observations showed that the state of health of the calves was satisfactory, and no pronounced differences between the groups were found. The animals of the experimental groups did not suffer from diarrhea. Recovery of the body after diarrhea in cattle can take up to 30 days.

2.4. Economic effectiveness of probiotics

The final stage of the experiment to determine the expediency of researching the use of probiotics in the diets of young animals is the calculation of economic efficiency. The obtained results of the economic effectiveness of the use of probiotics in calves from the 5th to the 60th day of life are shown in Table 4.

According to the economic efficiency calculation results of the conducted studies, it was established that the calves of the experimental groups, which were fed probiotic preparations, had higher daily gains compared to the control group. 26 % of all control group animals had adaptation problems. As a result, their productivity decreased by 500 g

of daily gain. For 60 days of research, the group lost 48 kg of gains. Recovery of the body after diarrhea in cattle can take up to 30 days. Therefore, we can talk about undernutrition up to 100 kg of body weight. According to the prices of the meat market of the Volyn region, cattle were accepted
at 40 UAH per 1 kg of live weight. The total losses amounted to 4 thousand UAH or 1 thousand hryvnias. The price of medicines – UAH 500 and the work of a veterinary medicine specialist – UAH 400 should be added to the total costs. Therefore, the total amount of damages is UAH 5,000.

Table 4

The economic efficiency of using probiotics in feeding young animals of the Volyn beef breed (M±m, n=8)

Indicators	Group of animals		
	Control	I Experimental	II Experimental
1	2	3	4
Number of animals in the group, heads	8	8	8
The cost of additives, UAH/pack	0	154,50	162,7
Body weight of 1 head at the beginning of the study, kg	44,4±1,08	44,1±1,25	44,8±1,13
Gross body weight at the beginning of the study, kg	666,0	661,5	672,0
Body weight of 1 head at the end of the study, kg	143,4±1,06	152,6±1,44*	155,3±1,29*
Gross body weight at the end of the study, kg	2151,0	2289,0	2329,5
Absolute growth, kg	99,0	107,8	111,2
Average daily increase, g	550,0	599,0	617,8
The cost of the body weight of 1 head at the end of the period, including supplements, UAH	0	23576,7	25267,3
Profit, UAH		15650,5	1754,5

Примітка: *−P<0,05

In the experimental groups, which animals were fed probiotics of different microbiological composition, disorders of the gastrointestinal tract during critical periods were not observed. The economic efficiency of the use of this drug is UAH 968 for the head.

CONCLUSIONS

According to the results of our experimental studies on the effect of probiotics *Bacillus Subtilis* and *Lactobacillus spp*. The following conclusions can be made about the immunophysiological state of dairy calves indicators of their growth and development:

1. When the calves were given probiotics, hematopoiesis indicators normalized; however, we found an increase in the content of erythrocytes – 1.08; 1.08 and 1.09 times; hemoglobin – 1.14; 1.03 and 1.14 times; hematocrit value – 1.08; 1.07 and 1.08 times.

2. Our studies have also shown that the applied probiotics contribute to the improvement of biochemical indicators: a positive effect on the total protein content was noted – by 1.12, 1.14, and 1.15 times, albumin fraction – 1.05; 1.05 and 1.07 times, globulin content – 1.22; 1.25 and 1.26 times.

3. In specific age periods, probiotic supplements had a different degree of influence on indicators of natural resistance of young animals. The difference between indicators of blood bactericidal activity under the action of *Lactobacillus spp.*, in comparison with the control, was probable at the age of 30 days (16.9%, $P<0.01$), and under the action of *Bacillus Subtilis* – at the age of 60 days (25.5 %, $P<0.001$). The lysozyme activity of the blood serum of young animals was significantly higher compared to the control in 60-day-old animals (27.2%, $P<0.001$). In the 2nd experimental group, probably higher indicators were found in 30-day-old calves compared to the control group (19.2%, $P<0.01$). The level of phagocytic and complementary activity of the blood was probably the highest, compared to calves of the control groups, at the age of 60 days. Thus, in the 1st research group – by 17.2% ($P<0.001$) and 32.6% ($P<0.001$), in the II research group – by 23.2% ($P<0.001$) and 36.3% ($P <0.001$), respectively.

4. The use of probiotics had a positive effect on the immunological status of the calves. The level of immunoglobulins in all age periods was higher in the II research group of animals given *Lactobacillus spp*.

5. Using probiotics for dairy calves strengthened metabolic processes, increasing their economic and valuable indicators. Thus, the best growth indicators were in the calves of the II research group. The average daily growth of calves was more significant, compared to control animals, in the 1st experimental group when fed the probiotic *Bacillus Subtilis* – by 1.9%, and in the 2nd experimental group, when fed the probiotic based on *Lactobacillus spp*. – by 5%.

6. The economic efficiency of using a probiotic based on *Lactobacillus spp*. is UAH 968 for the head

SUMMARY

According to research results, the positive effect of probiotics *Bacillus Subtilis* and *Lactobacillus spp*. on the young Volyn meat breed's physiological, immunological, and zootechnical indicators.

Based on the obtained results, it is possible to recommend probiotics *Bacillus Subtilis* and *Lactobacillus spp.* as drugs to facilitate adaptation processes in young animals during critical ontogenesis periods.

Taking into account that during the critical periods of the ontogenesis of young animals of the Volyn meat breed, phenomena are observed that lead to a significant decrease in the number of young animals, which in the future has a considerable impact on the productivity of the herd as a whole, it is advisable to continue conducting research in this direction on other age groups of animals.

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