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INNOVATIVE APPROACHES TO ENHANCING MEAT PRODUCTIVITY IN QUAIL USING FINISH EXTRUDED COMPOUND FEEDS SUPPLEMENTED WITH PHYTOBIOTICA

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The article presents the results of experimental study of the effect of extruded compound feeds with the BioFeed-P phytobiotic additive on meat productivity and the physiological state of Texas quails. The relevance of the study is determined by the need to identify effective and safe alternatives to antibiotic growth promoters under conditions of intensified poultry production. The experiment was conducted on meat-type quail divided into control and experimental groups. It was established that the use of extruded compound feed supplemented with a phytobiotic contributed to a 3.84% increase in the live body weight of quail by the end of the fattening period, as well as to increases of 31.0% and 30.3% in absolute and average daily weight gain, respectively. Improved meat quality parameters were also observed: the protein content in the muscle tissue of the experimental group was 1.8% higher, while no statistically significant differences were found in fat and ash content. Blood biochemical parameters remained within physiological reference ranges, indicating that the experimental diet had no adverse effects on metabolic processes or the functional status of the birds. The obtained results confirm the potential of extruded compound feeds supplemented with phytobiotics for enhancing meat productivity and improving product quality in quail production.

Key words: *fortified animal feed, phytobiotics, meat productivity, average daily gain, slaughter yield, blood biochemistry.*

ФИТОБИОТИКТЕРМЕН ЭКСТРУДИРЛЕНГЕН FINISH ҚҰРАМА ЖЕМДІ ҚОЛДАНУ АРҚЫЛЫ БӨДЕНЕНІҢ ЕТ ӨНІМДІЛІГІН АРТТЫРУДЫҢ ИННОВАЦИЯЛЫҚ ТӘСІЛДЕРІ

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Мақалада Biofeed-P фитобиотикалық қоспасы бар экструдирленген құрама жемнің Техас бөденесінің ет өнімділігі мен физиологиялық жағдайына әсері туралы эксперименттік зерттеу нәтижелері келтірілген. Жұмыстың өзектілігі құс шаруашылығының қарқындылығы жағдайында антибиотикалық өсу стимуляторларына тиімді және қауіпсіз балама іздеу қажеттілігіне байланысты. Эксперимент бақылау және эксперименттік топтарға бөлінген ет бағытындағы бөдене-лерде жүргізілді. Фитобиотик қосылып экструдирленген құрама жемді пайдалану бордақылаудың соңына қарай бөденелердің тірі салмағының 3,84% -ға, абсолютті және орташа тәуліктік өсімнің 31,0% -ға және 30,3% -ға артуына ықпал еткені анықталды. Еттің сапалық көрсеткіштерінің жақсарғаны атап өтілді: эксперименттік топтың бұлшықет тініндегі ақуыз мөлшері, май мен күл құрамындағы сенімді айырмашылықтар болмаған кезде 1,8% -ға жоғары болды. Қанның биохимиялық көрсеткіштері физиологиялық норма шегінде болды және эксперименттік диетаның метаболи-калық процестерге және құс денесінің функционалды жағдайына теріс әсерінің жоқтығын көрсетті. Алынған нәтижелер ет өнімділігі мен қайта өсіру өнімдерінің сапасын арттыру үшін фитобиотик қосылып экструдирленген құрама жемді қолдану перспективасын растайды.

Түйінді сөздер: *байытылған құрама жем, фитобиотиктер, ет өнімділігі, орташа тәуліктік өсім, сою өнімділігі, қан биохимиясы.*

ИННОВАЦИОННЫЕ ПОДХОДЫ К ПОВЫШЕНИЮ МЯСНОЙ ПРОДУКТИВНОСТИ ПЕРЕПЕЛОВ ПУТЁМ ИСПОЛЬЗОВАНИЯ ЭКСТРУДИРОВАННЫХ КОМБИКОРМОВ FINISH С ФИТОБИОТИКАМИ

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В статье представлены результаты экспериментального исследования влияния экструдированных комбикормов с фитобиотической добавкой BioFeed-P на мясную продуктивность и физиологическое состояние перепелов техасской породы. Актуальность работы обусловлена необходимостью поиска эффективных и безопасных альтернатив антибиотическим стимуляторам роста в условиях интенсификации птицеводства. Эксперимент проведён на перепелах мясного направления, разделённых на контрольную и экспериментальную группы. Установлено, что использование экструдированного комбикорма с фитобиотиком способствовало увеличению живой массы перепелов к концу откорма на 3,84%, повышению абсолютного и среднесуточного прироста на 31,0% и 30,3%. Отмечено улучшение качественных показателей мяса: содержание белка в мышечной ткани экспериментальной группы было выше на 1,8% при отсутствии достоверных различий по содержанию жира и золы. Биохимические показатели крови находились в пределах физиологической нормы и свидетельствовали об отсутствии негативного влияния экспериментального рациона на обменные процессы и функциональное состояние организма птицы. Полученные результаты подтверждают перспективность применения экструдированных комбикормов с фитобиотиками для повышения мясной продуктивности и качества продукции перепеловодства.

Ключевые слова: *обогащенные комбикорма, фитобиотики, мясная продуктивность, среднесуточный прирост, убойный выход, биохимия крови.*

Introduction. The modern development of the agro-industrial complex is characterized by the active introduction of innovative technologies aimed at increasing the productivity of agricultural animals and birds, ensuring biosafety and reducing production costs. In poultry farming, special attention is paid to the development of effective feed solutions, since feed costs account for up to 65-70% of the cost of production [1, p. 18; 2, p. 12005].

Quail farming is a promising branch of poultry farming due to high precocity, intensive growth and valuable dietary properties of quail meat and eggs [3, p. 40; 4, p. 3]. However, the realization of the genetic potential of poultry largely depends on the completeness of feeding and the use of modern feed technologies.

Quail meat is popular among health-conscious consumers due to the high protein to fat ratio, low cholesterol content and minimal intramuscular fat [5, p.131]. Quail meat contains 25-27% dry matter, 21-22% protein, 2.5-4.0% fat, as well as a significant number of vitamins, minerals and essential amino acids [6, p. 226].

The success of a poultry enterprise largely depends on feeding and housing practices. Housing systems significantly affect poultry production and product quality [7, p. 102]. Often compound feeds are incomplete in nutritional value, which requires the inclusion of additives. Recently, the feed industry has paid considerable attention to a relatively new category of feed additives known as phytogenic feed additives obtained from spices, herbs or aromatic plants [8, p. 550; 9, p. 3; 10, p. 122].

Extrusion of feed components is considered one of the most effective technologies for processing raw materials, contributing to increased digestibility of nutrients, inactivation of anti-nutritional factors and improvement of sanitary and hygienic indicators of feeds [11, p. 44; 12, p. 67]. Combining extrusion processing and the use of phytobiotics allows such compound feeds to be considered as an innovative tool for increasing the efficiency of quail farming production.

Tushar Verma (2019) investigated the effectiveness of twin-screw extrusion in reducing Salmonella levels taking into account fat content, moisture, temperature and screw speed. At temperatures above 65 °C, the number of bacteria was below the detection limit (<10 CFU/g) [13, p. 5]. The thermal resistance of different microbial groups varies greatly depending on their structure, composition and resistance mechanisms. A striking example of such diversity is the difference in thermal resistance between vegetative cells and spores of the same bacterial species. Ascospores are particularly heat-resistant, similar to bacterial spores [14, p. 818].

The effectiveness of extrusion is explained by the combined effect of temperature, which in this process ranges between 150-180°C, and pressure of 50 atm. In addition, extrusion extends the shelf life of feed by significantly reducing moisture content. The use of extruded by-products of grain and legume crops provides

nutritional, economic and environmental benefits. Processing these wastes by extrusion improves their nutritional properties, and heat treatment helps stabilize rancidity and provides microbiological control [15, p. 87].

The growing demand for natural feed additives in poultry farming is due to the ban on the use of antibiotics as feed additives. Currently, the feed industry is focusing on new categories of additives called phytogenic or phytobiotics, which are produced from extracts of herbs, aromatic plants and spices. The successful use of phytogenic growth stimulants brings great benefits to the poultry industry by increasing feed efficiency and improving health status [16, p. 7].

Analysis of the data suggests the need to study the effect of phytobiotics and extruded feeds in the quail diet on bird health and productivity, as well as the quality and safety of quail farming products. In this study, we present data on the effect of the developed Finish compound feed formulation on meat productivity and nutritional value of quail meat.

In our study, the compound feed was enriched with the phytobiotic feed additive BioFeed-P, which contains more than 250 biologically active components, including fatty acids, flavonoids, organic acids, essential oils, vitamins A, C, P, microelements, amino acids and other biologically active compounds. The feed additive has bactericidal, fungicidal, antiviral, anti-inflammatory, antiseptic, immunostimulating, detoxifying, tonic, regenerative and analgesic properties [17, p. 3].

Purpose: to evaluate the effect of feeding Texas quails with extruded compound feeds enriched with phytobiotics on their physiological parameters and meat productivity, as well as to determine the effectiveness of these diets as an alternative feeding solution compared to traditional compound feeds.

Objectives:

- To determine the chemical composition and energy value of the compound feeds used.
- To establish the effect of extruded compound feeds with phytobiotics on the growth performance and physiological condition of Texas quails.
- To evaluate the impact of the studied diets on the meat productivity of quails, including slaughter indicators, chemical, and mineral composition of meat.
- To analyze the changes in biochemical blood parameters of quails when using extruded compound feeds with phytobiotics compared to traditional diets.

Materials and methods. The experiments were carried out at a quail farm in Akmola region from June to August 2024. The object of the study was Texas breed quails (meat direction) in the amount of 360 heads. For the experiments, two groups were formed: control (CG) and experimental (EG).

Quails in the control group received the standard farm ration using commercial compound feed. Birds in the experimental group received enriched extruded compound feed Finish, developed by NFT-KATU LLP on the basis of S. Seifullin KATRU. The feed recipe was compiled based on the recommendations of Nutrient Requirements of Ring-Necked Pheasants (1994) and the recommendations of the All-Russian Research and Technological Institute of Poultry Farming (VNITIP). The composition included extruded corn, wheat, soybean meal/cake, fish meal, tricalcium phosphate (TCP), feed yeast, ground shell and chalk, table salt, activated carbon and phytobiotic feed additive BioFeed-P.

The chemical composition of the compound feed was analyzed using the NIRS DS2500 infrared analyzer (FOSS Analytical A/S, Denmark).

Quail chicks were kept in cages equipped with drinkers, temperature and humidity sensors. The stocking density was 118-119 heads/m² in accordance with the recommended standards for growing quails. Feeding was carried out from 7 days of age until 63 days.

Weighing was carried out using standard zootechnical methods. Birds were weighed individually upon arrival (160 heads), then every 7 days until the end of the experiment using electronic scales. During the trial, both groups of birds were kept under identical conditions. Feed was distributed manually according to the experimental scheme: in the first 2 weeks, chicks were fed 3 times a day, then 2 times a day. At 63 days of age, the birds were sent for slaughter to study meat productivity and chemical composition of meat. The morphological composition of internal organs and tissues was studied after slaughter by anatomical dissection in accordance with standard recommendations. All parameters except live weight were determined during anatomical dissection of carcasses, carried out in accordance with a single methodology developed by VNITIP, as well as interstate GOST 18292-2012 “Agricultural poultry for slaughter. Technical conditions”, GOST 31962-2013 “Chicken meat (carcasses and parts)” and GOST R 54673-2011 “Quail meat (carcasses). Technical conditions”.

The chemical composition of quail muscle tissue was determined by standard methods: sampling was carried out in accordance with GOST 9792-73, moisture content – according to GOST 9793-74, fat content – according to GOST 23042-78, protein content – according to GOST 25011-81.

To assess the effect of the developed feed on metabolic processes in quail blood, the following indicators were studied: total protein (TP), albumin and globulins, total bilirubin, urea, calcium, glucose, amylase activity, alanine aminotransferase (ALT), aspartate aminotransferase (AST). Meat productivity was determined by weekly individual weighing and after slaughter with the study of meat productivity indicators.

Blood analysis was performed on the SMT-120V veterinary biochemical analyzer (Chengdu Seamaty Technology Co., China, Sichuan), which operates on the basis of absorption spectroscopy and transmission turbidimetry. Blood samples were taken by decapitation using simple random sampling. Before blood sampling,

the birds were on a 6-hour fasting diet. After slaughter of the birds, blood samples for biochemical analysis were collected into 1.5 ml tubes with activator and gel, followed by centrifugation at 3000 rpm for 10 minutes on a CM-6M centrifuge (Sia «Elmi», Latvia, Riga). Statistical analysis was performed using SPSS 25.0 application.

Results and discussion. Achieving high productivity and product quality is impossible without providing birds with a complete and balanced diet, which should be formulated in accordance with the intended production direction. The metabolizable exchange energy of the compound feed we developed was 3357 kcal/kg, which is considered a high level. For comparison, NRC recommends a diet with metabolizable energy (ME) of 2900 kcal/kg for Japanese quails in the starting phase and laying phase.

To optimize feeding schemes, it is important to determine the energy value of feeds and also establish the ideal energy consumption by the bird to ensure maximum economic return. The chemical composition of the rations of the experimental groups is presented in Table 1.

Table 1 – Chemical composition of quail rations

Group	Moisture, %	DM, %	Crude protein, %	Crude fat, %	Crude fiber, %	Ash, %	Starch, %	ME (poultry), Kcal
CG	9,3	90,7	25,3	6,9	3,88	6,57	28,83	3309
EG	8,3	91,7	27,6	5,0	3,49	5,38	32,79	3357

As can be seen from Table 1, in the commercial feed used in CG, the level of metabolizable energy was lower by 48 Kcal, but in both groups the indicator corresponds to a high level. According to the Guide to Working with Meat Quails, metabolizable energy should be 3100 Kcal/1000 g, protein in the feed – 20%. Due to the fact that the feed components are subjected to extrusion processing, its moisture content is reduced, which allows extending the shelf life by reducing the risk of microorganisms and mold development. In the EG compound feed, the moisture content was 8.3%, in CG – 9.3%, which also improves the properties of the manufactured extruded compound feed and ensures longer storage.

An important indicator of the nutritional and energy value of feed is dry matter. The dry matter content indicates the actual amount of various nutrients available to the bird consuming the feed. Dry matter contains inorganic (crude ash) and organic components. The organic matter in the feed consists of crude protein, crude fat and carbohydrates. The compound feed we developed contained 91.7% dry matter, while the CG feed contained 90.7%. The percentage of protein in the EG feed was 27.6%, in CG – 25.3%, which indicates sufficient protein supply to the bird's body and satisfaction of their needs. Fiber is digested in the bird's body in the cecum, where microorganisms are located that secrete enzymes capable of breaking down 10 to 30% of fiber. The crude fiber content should be at the level of 4.0-5.0%, in our case this indicator is slightly reduced and is 3.49% in EG and 3.88% in CG. Carbohydrates are the main sources of energy for birds. The starch percentage in the EG feed was slightly higher than in CG and was 32.79% and 28.83%, respectively. Ash content is generally recognized as the most important indicator for assessing the mineral composition of a product. The EG feed contained 5.38% ash, and CG – 6.57%.

The dynamics of quail growth from day 45 to day 63 using the Finish compound feed recipe is presented in Table 2.

Table 2 – Fattening results using the Finish recipe

Age, days	Average weight, g	
	control group	experimental group
45	280,1±3,96	278,5±3,6
56	324,1±5,02	319,0±4,27
63	325,6±5,14	338,1±4,48

At the beginning of the fattening period, quails in the experimental group had a weight difference of 1.6 g. By the middle of fattening, quails in EG weighed 5.1 g less than in CG. However, by the end of the experiment, weight gain in CG stopped, with an increase of only 1.5 g per week, which indicates that the birds reached the maximum weight gain potential based on the nutritional value of the provided feed. In contrast, EG birds continued to gain weight, showing an increase of 19.1 g.

Values of absolute, average daily and relative weight gain during the fattening period are shown in Figure 1.

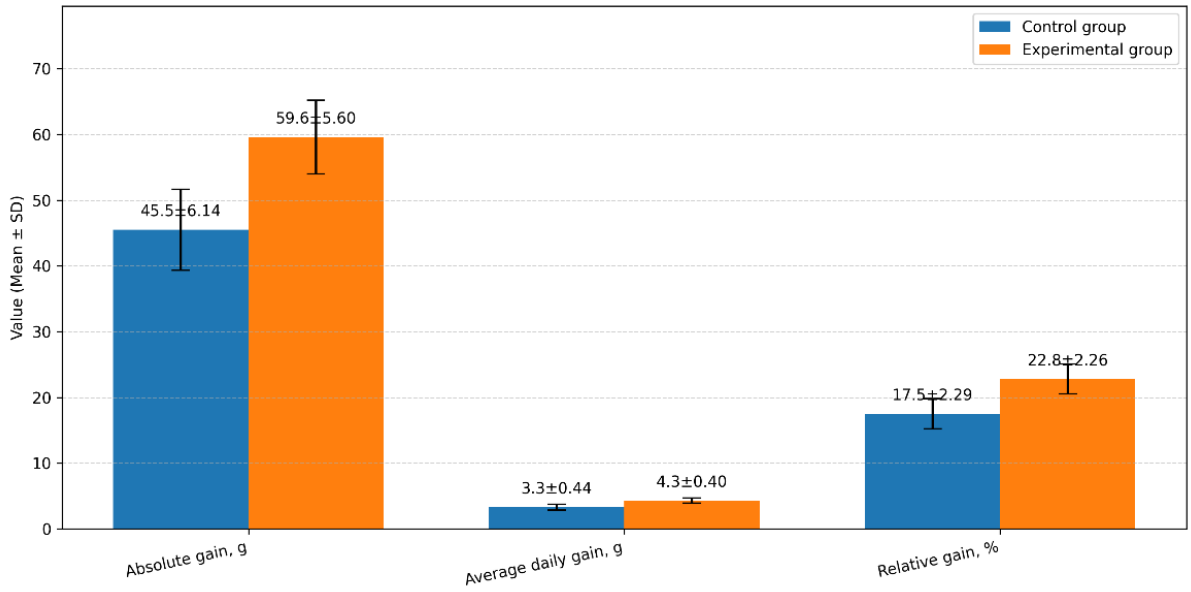

Figure 1 – Quail meat productivity indicators

When calculating the absolute gain, it was revealed that the difference between the groups was 15.1±8.6 g. The average daily gain in birds was 3.3±0.44 g in CG and 4.3±0.4 g in EG, which is 1 g more. The relative gain, showing the growth intensity in EG, was higher by 5.6±3.33%.

Meat productivity was assessed based on the values of pre-slaughter live weight, semi-eviscerated and eviscerated weight, slaughter yield and weight of internal organs. During veterinary and sanitary examination of quail carcasses, no pathological changes or hemorrhages were observed. All carcasses were found to be benign according to post-slaughter examination results. The results of meat productivity studies are presented in Table 3.

Table 3 – Meat productivity indicators

Indicator	Group (n=50)	
	control	experimental
Pre-slaughter weight, g	339±12,66	323±14,81
Weight of semi-eviscerated carcass, g	259±10,16	253±24,75
Weight of eviscerated carcass, g	225±12,50	200±20,70
Slaughter yield, %	66,3	61,9
Weight of internal organs:		
Muscular stomach, g	3,39±0,40	3,41±0,52
Heart, g	2,34±0,07	2,27±0,15
Liver, g	4,68±1,16	6,12±1,05

As shown in Table 3, the highest slaughter characteristics were observed in the experimental group. The data indicate that in the experimental group, where birds received feed according to the developed formula, the pre-slaughter weight was higher with a difference of 4.95% or 16 g. The weight of the semi-eviscerated carcass was also higher by 6 g in the experimental group. Eviscerated carcasses of the experimental group exceeded the control group by 12.5%.

In addition, the slaughter yield (the percentage ratio of eviscerated carcass weight to pre-slaughter weight) was higher in the experimental group (66.3%) compared to the control group (61.9%). This suggests more efficient use of the bird's mass from the experimental group.

Thus, the use of the developed Finish compound feed formulation with phytobiotic enrichment can contribute to an increase in pre-slaughter weight, carcass weight and slaughter yield in birds.

For scientific interpretation of the data regarding the influence of the compound feed formulation with phytobiotic and extruded components in the quail diet, we analyzed changes in the weight of the stomach, heart and liver between the experimental and control groups. In the experimental group, the average stomach weight was 3.39±0.40 g, while in the control group it was 3.41±0.52 g. These results indicate the absence of a significant difference in stomach weight between the experimental and control groups. In the experimental group, the average heart weight was 2.27±0.15 g, compared to 2.34±0.07 g in the control group. The results

show that the average heart weight in the experimental group was not significantly lower than in the control group. In the experimental group, the average liver weight was 23.5% greater than in the control group. The increase in liver weight in the experimental group quails, in our opinion, reflects the adaptive restructuring of metabolism against the background of higher digestibility and bioavailability of nutrients in the extruded compound feed, as well as enhancement of lipid and carbohydrate metabolism functions and bile formation under the influence of phytobiotic.

In addition to meat productivity, the mineral composition of quail meat was also studied, which is shown in Table 4.

Table 4 – Chemical composition of quail meat

Indicator	Control group	Experimental group
Physico-chemical indicators:		
Protein mass fraction, %	21,49±0,64	21,89±0,41
Fat mass fraction, %	3,13±1,49	3,16±1,21
Carbohydrate mass fraction, %	not detected	not detected
Ash mass fraction, %	1,29±0,02	1,28±0,02

Data from Table 4 demonstrate that the chemical composition of quail meat in both groups is characterized by high protein content and low fat, which confirms its high nutritional value and dietary properties. The protein content in the meat of quails of the experimental group was 1.8% higher than in the control group. This indicates the positive effect of the diet used in the experiment, which leads to protein accumulation in muscle tissue. The mass fraction of fat and ash were approximately at the same level, which indicates the stability of these parameters, although the experimental group has some advantages. Carbohydrates were not detected in the meat samples, which is typical for quail muscle tissue and further emphasizes its high-protein and low-calorie nature.

The results of the study of the mineral composition of quail meat are presented in Figure 2.

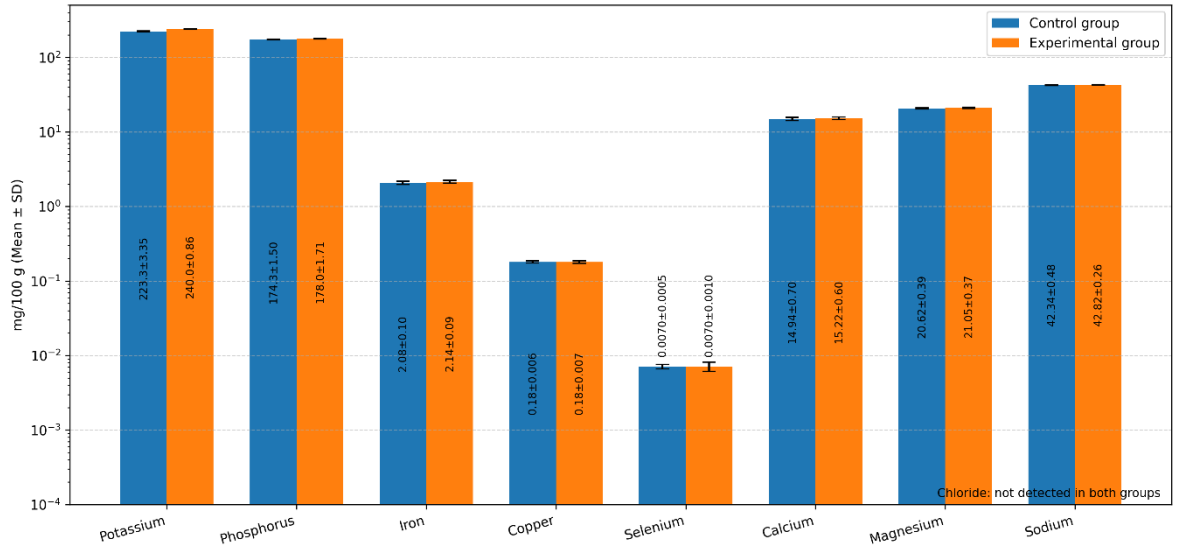

Figure 2 – Mineral composition of quail meat

Overall, the profile of macro- and microelements in the meat of birds of the control and experimental groups is comparable, with a tendency towards higher average values in the experimental group for a number of indicators.

The most pronounced differences were observed in potassium content: in CG – 223.3±3.35 mg/100 g, in EG – 240.0±0.86 mg/100 g, which corresponds to an increase in the average value by 16.7 mg/100 g. Potassium is one of the key intracellular cations and reflects the features of electrolyte status and mineral profile of muscle tissue. Phosphorus content was also slightly higher in the experimental group (178±1.71 mg/100 g) compared to the control (174.3±1.50 mg/100 g), however, the differences in magnitude are small. Concentrations of calcium and magnesium in the experimental group exceeded the control values by 0.28 and 0.43 mg/100 g, respectively. These elements are involved in the formation of structural and functional properties of muscle tissue and regulation of enzymatic processes, therefore the identified shifts may reflect the peculiarities of mineral supply of the diet, including extruded components and phytobiotic, and differences in the absorption of minerals when using different diets.

Similarly, sodium content was slightly higher in the experimental group (42.82±0.26 mg/100 g) compared to the control (42.34±0.48 mg/100 g), which corresponds to a small difference in magnitude (0.48 mg/100 g) and likely reflects the variability of the indicator within the physiological range.

For iron, a slight increase in the average value was noted in the experimental group (2.14±0.09 mg/100 g) relative to the control (2.08±0.10 mg/100 g), while for copper and selenium the indicators between the groups were practically indistinguishable (Cu: 0.18 mg/100 g; Se: 0.007 mg/100 g in both groups within measurement errors). Chlorine was not detected in the studied samples, which indicates values below the detection limit or complete absence.

Thus, the mineral composition of quail meat in the experimental group is characterized by a tendency to increase potassium content, as well as a slight increase in calcium, magnesium and sodium while maintaining comparable levels of iron, copper and selenium. The mineral profile of quail meat in EG was generally comparable to CG, with a tendency toward higher mean values for several elements, most notably potassium, and minor increases in calcium, magnesium, and sodium. These shifts may reflect differences in dietary mineral supply and/or nutrient utilization associated with the tested feed formulation and processing, while remaining within physiologically acceptable ranges. It is important that all data are within the regulated range for these minerals, indicating a well-balanced diet.

The results obtained in assessing the effect of the developed compound feed on blood parameters of quails are presented in Table 5. Overall, indicators of protein, carbohydrate and nitrogen metabolism, as well as markers of liver functional state by transaminase activity in birds of both groups were in comparable ranges, while differences in average values were noted for individual parameters.

No significant discrepancies were found in protein metabolism indicators presented in Table 6. For the indicators where the average value in CG exceeded EG, the following was established: globulin content in CG was higher by 25.7% (18.00±21.35 versus 14.32±0.89 g/l), total bilirubin level – higher by 27.27% (3.50±0.99 versus 2.75±0.84 μmol/l, both values correspond to low levels and do not themselves indicate signs of hyperbilirubinemia), glucose concentration – higher by 7.68% (16.68±0.80 versus 15.49±0.48 mmol/l, both values are substantially higher than the thresholds characteristic of hypoglycemia), calcium content – higher by 3.46% (2.39±0.09 versus 2.31±0.11 mmol/l, which is consistent with the relative stability of calcium homeostasis with adequate mineral intake), and urea – higher by 27.18% (2.48±0.72 versus 1.95±0.24 mmol/l).

Table 5 – Assessment of the effect of the developed feed on metabolic processes in quail blood

Indicator	Control group	Experimental group
Albumin, g/l	12,23±2,93	13,67±0,48
Total protein (TP), g/l	27,33±8,94	27,8±1,11
Globulin, g/l	18,0±21,35	14,32±0,89
Total bilirubin, μmol/l	3,5±0,99	2,75±0,84
AST, U/l	382±42,75	403±44,95
ALT, U/l	11,67±3,34	11,67±1,8
Glucose, mmol/l	16,68±0,8	15,49±0,48
Calcium (Ca), mmol/l	2,39±0,09	2,31±0,11
Urea, mmol/l | 2.48±0.72 | 1.95±0.24	2,48±0,72	1,95±0,24

With comparable levels of total protein and albumin, the decrease in urea reflects the intensity of amino acid utilization, but both values were within physiological limits. Both an increase and a decrease in blood urea content can be fraught with consequences for the bird's body. Urea and creatinine are indicators of normal kidney function, and their increase in serum indicates kidney dysfunction or protein overfeeding. A decrease in plasma/serum urea levels occurs less frequently and usually has less clinical significance than an increase in serum urea levels [18, p. 488].

ALT activity in both groups was the same – 11.67 U/l (CG: 11.67±3.34; EG: 11.67±1.8). The absence of intergroup differences in ALT indicates the absence of pronounced shifts in this indicator against the background of the use of the developed feed. AST activity was high in both groups; in the experimental group the average value was higher by approximately 5.5%. Such a difference is moderate in nature and does not in itself indicate a pathological process. In birds, AST is a less specific indicator, since it is present not only in the liver, but also in muscle tissue, therefore an increase in AST may reflect both metabolic features and intensive growth, as well as the influence of stress factors, for example, during blood sampling.

Taken together, the growth and slaughter indicators suggest that the developed EG diet provided favorable nutritional conditions during the finishing period. The potential contribution of diet composition and processing factors is considered further in the context of published evidence.

In scientific discourse, the position is widespread that the use of natural feed additives as growth stimulants in poultry diets has a positive effect on egg production, meat production, reproduction and health and minimizes the use of antibiotics as growth stimulants [19, p. 170].

Corn, wheat and soybean meal are the main components of poultry diets, providing a significant share of energy and protein. Traditional sources of fiber-rich by-products include wheat bran, sunflower meal, cottonseed meal, oat bran, soybean meal and pea meal [20, p. 642].

M.T. Sisay et al. [21, p. 2651] reported that extruded wheat-based products are relatively low in protein and high in gluten, and have a high glycemic index. Due to the high protein content in legumes, they are considered crops that satisfy the need for plant protein in poultry diets [22, p. 33]. According to published data, extrusion processing can improve hygienic quality of compound feeds by reducing microbial and fungal contamination risks, which is an important technological factor when assessing feed safety. As stated by the authors D.D. Loy and E.L. Landy, corn starch is almost 100% digestible, and its content can be increased by grain processing [23]. M.M. Rakhman et al. found that groups of quails receiving specific combinations of olive oil and lime juice showed improved intake and weight gain [24].

Overall, birds receiving the developed extruded Finish compound feed with BioFeed-P tended to show higher growth intensity and improved slaughter-related outcomes compared with the control diet. At the same time, the absence of pronounced intergroup differences in key biochemical blood parameters indicates that the tested feeding strategy did not exert an adverse physiological load under the conditions of the experiment.

Thus, the stability of major metabolic indicators supports the physiological tolerability of the developed diet during the finishing period. In combination with the productive performance data, these findings justify further evaluation of extruded diets with phytobiotics in quail feeding programs, including studies with expanded sample sizes and additional functional endpoints.

Conclusion. The developed us Finish compound feed formulation is characterized by high energy value and lower moisture content, as it is produced through extrusion, which accordingly results in higher dry matter content and increased protein level while maintaining other parameters comparable to commercial compound feed. Overall, this indicates its potentially superior technological properties.

The conducted study demonstrated that the use of extruded compound feed Finish, enriched with the phytobiotic additive BioFeed-P, in the diet of Texas quails ensures a more efficient realization of the birds' productive potential compared to commercial compound feed. Increased growth intensity and improved meat productivity indicators indicate better utilization of metabolizable energy and dietary nutrients, as well as targeted muscle tissue development without negatively affecting meat quality characteristics. The chemical composition of meat from the experimental group was characterized by higher protein content while maintaining optimal levels of fat and minerals, confirming the improvement of the product's nutritional value.

At the same time, the absence of clinically significant changes in blood biochemical parameters and liver enzyme activity indicates the maintenance of physiological homeostasis and metabolic safety of the developed compound feed. The obtained results allow the combination of extrusion processing of feed components and phytobiotic additives to be considered a scientifically substantiated and sustainable alternative to traditional compound feeds in meat quail production, meeting modern requirements for efficiency, biosecurity, and reduced dependence on antibiotic growth stimulants.

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ХАРАКТЕР И ЛОКАЛИЗАЦИЯ РАНЕНИЙ У ДИКИХ ЖИВОТНЫХ ПРИ БРАКОНЬЕРСТВЕ В СЕВЕРНОМ КАЗАХСТАНЕ

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В результате изучения характера и локализации ранений на теле диких животных при незаконной добыче в Северном Казахстане было установлено, что наиболее часто незаконному отстрелу в Северном регионе Казахстана подвергается сибирская косуля (48%), на втором месте по количеству экспертиз были сайга (12%) и дикий кабан (11%). Отстрел лисы (6%), и волка (5%) был зафиксирован только в первые два года исследований.

Максимальное количество уголовных дел по статье о браконьерстве было зарегистрировано в 2021 году. Их количество к 2024 году сократилось на 74,2%.

На одно добытое животное приходится, в среднем, 3 огнестрельных ранения. При этом, наибольшее количество ран от общего числа огнестрельных ранений обнаружено у кабанов (44,3%)