Use of extruded lupin in feeding young quails

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Abstract. In this study, the effect of feeding extruded white lupine seeds of Dega variety on the productive performance and physiological condition of young quails was investigated. The experiment was conducted on 160 quails of Texas breed, which were divided into 2 groups. The first group was fed extruded soybean seeds (control) as a part of mixed fodder, in the diets of the second group soybean was replaced by extruded white lupine seeds equivalent in protein. During the period of quail rearing, daily records of feed digestibility and physiological condition of birds were made, weekly weighing and weight of quails were determined. To study the physiological condition of experimental birds, morphological and biochemical blood parameters were determined. As a result of the experiment it was found that inclusion of extruded white lupine seeds in the diet promoted a reliable increase in body weight of quails by 2.6% ($p \geq 0.05$), while feed costs per unit of gain decreased by 3.4%. In the blood of quails, haemoglobin level and haematocrit increased by 9.8 and 21.8% ($p \geq 0.05$), indicating oxygen saturation of blood cells. The enzymatic activity of alkaline phosphate by 18.6%, ALT by 74.3%, AST by 17.8%, GGT by 59.6% decreased in blood, indicating normal metabolism in the body of young quails.

1 Introduction

Quail breeding is a unique branch of poultry farming, as quails have a number of distinctive features and advantages: high growth rate (on average 4-5 times higher than that of chickens), early maturity (egg production occurs at 5-6 weeks of age, and meat breeds reach a slaughter weight of 350-400 g by this time) [1]. Therefore, quail breeding is the most profitable branch of poultry farming. At the same time, the aspects of scientifically based feeding of quails, protein and energy nutrition of feed mixtures, the need for macro- and microelements and vitamins are insufficiently studied.

As it is known, the fundamental factor in feeding poultry is protein nutrition of mixed fodders. According to literature data, the required protein intake rate differs depending on the age, breed and type of birds. So, at intensive breeding of quail chicks for meat at the age of 1 to 4 weeks they need to receive not less than 25% protein, further the amount of protein during fattening will be not less than 21%. The amount of protein for laying quails is up to 25%. When calculating the need for protein, it is also necessary to take into account its completeness, which is determined by the amino acid composition. Quails, like other birds, are sensitive to the lack of cysteine, lysine, methionine, tryptophan. The growth and productive health of quail depends on these amino acids [2, 3]. No less important criterion is the quality and digestibility of protein in the diet, hence the efficiency of feed nitrogen utilisation by poultry.

According to scientists, the balance between energy and protein in the feed mixture for quail is of great importance. These indicators guarantee high productivity and reproductive qualities of the growing birds. It has been found that feeding a feed mixture with high protein but low carbohydrates and fats leads to metabolic disorders, resulting in pathologies of the gastrointestinal tract and biliary tract. With a high-energy diet but with low protein levels, quail will be deficient in protein for building body tissues [4, 5].

Traditionally, expensive feeds of animal origin (meat and bone meal, fish meal, milk powder), leguminous crops, by-products of the processing industry (oilcakes, meal, pellets, etc.) are used as a source of protein in compound feeds. Today the world trend, including the Russian Federation, is the use of feedstuffs based on soya and its derivatives. Soybean seeds are rich in protein (up to 45%), which in addition contains the necessary proteinogenic amino acids. However, a significant disadvantage is that this crop is demanding to natural conditions and its yield is not so high on the territory of the Central region of Russia. In addition, most of the exported soybeans are genetically modified [6]

The above-mentioned facts indicate that the search for other, more optimal and qualitative sources of protein is relevant. Special attention should be paid to the leguminous crop Lupinus albus L. White lupin is usually used in feeding, which is characterised by a balanced amino acid composition, high nutrition, besides, the protein level in its seeds is 10% higher than that of peas, vetch and other leguminous crops [7]. According to R. Kriseldi et al. (2018), lupin seeds contain 34-39% (up to 46% crude protein in dry matter) protein and significant

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amounts of fats, carbohydrates, minerals, vitamins and vitamin-like substances [8].

However, 20% of lupin seeds are low nutrient hulls, in which 30% are hemicellulose and pectins, which after grinding can be effectively used as dietary fibre in animal diets and foods [11].

But the main reason restraining the use of lupin culture in poultry feed is considered to be the presence of alkaloids. Various processing methods including thermodynamic methods have been used to inactivate alkaloids [9]. One of these methods is processing in extruders at high pressure and a certain temperature regime (extruding). In addition, this method helps to increase the nutritional value of feed and its digestibility [10].

As a result of breeding work, new low-alkaloid lupin varieties with high content of organic matter, protein and mineral substances in seeds were obtained [12, 13]. White lupine of Dega variety is of the greatest interest. It is suitable for cultivation in the Central Black Earth, Middle Volga and Lower Volga regions [14]. The yield of this variety reaches 5 tonnes/ha, the vegetation period is 120 days, and the alkaloid content is less than 0.05% [15].

Researchers wrote that lupin is a promising protein product for the poultry industry [16]. The demand of soybean for poultry industry may be up to 1-1.5 million tonnes annually [17]. It is recommended to add non-alkoloidal (sweet) varieties up to 5-7%, depending on the age category, to poultry feed rations [18].

To date, scientific literature sources contain data on the favourable effect of lupine on poultry productivity. Experiments on laying hens, broiler chickens and quails have shown that replacement of soya meal in mixed fodders with crushed white lupine grain reduces feed cost, increases productivity, egg yield and weight, thus improving the profitability of production [19].

In the experiments of Z.N. Fedorova (2023) it was found that the inclusion of 10% and 15% of treated lupin seeds in the feed mixture for broiler chickens and 15% for adult stock has a positive effect on productivity and reduces feed costs per 1 kg of gain by 100 g [20].

In connection with the above, the purpose of the study was to investigate the effect of feeding extruded white lupine seeds on the physiological state and performance of young quails of the Texas quail breed.

2 Methods and materials

The scientific experiment was carried out according to the generally accepted methodology (VNITIP, 2000). We formed two groups of quails at 10 days of age of 80 birds each. Both groups of birds were kept in typical cages and the same conditions (temperature, humidity, light regime). According to the scheme of the experiment, quails received factory prepared compound feed (PC) in accordance with zootechnical norms (Kalashnikov A.P. et al., 2003). The diet of birds of the first group consisted of mixed fodder (95%) and extruded soya seeds (5%) (positive control). Birds of the second experimental group were fed extruded crushed white lupine seeds of Dega variety instead of soya equivalent in protein.

In the course of the experiment we kept records of safety and physiological condition of quails, weekly weighing was carried out to determine the dynamics of body weight gain. Daily record of feed digestibility was carried out, based on the obtained data, feed costs per unit of live weight gain were calculated.

Analysis of feeds and feed additives was carried out on express feed analyser NirstmDS 2500 Foss (Denmark). Dry matter, crude protein, crude fat, crude fibre, starch, crude ash, calcium, phosphorus were determined in the samples.

At the end of the experiment, blood sampling for morphological and biochemical studies was carried out in experimental quails. In the blood of birds the haemoglobin level was determined by the colorimetric haemoglobin cyanide method on a spectrophotometer Mindray BS 240 (China), the determination of the number of form elements was carried out in a Goryaev chamber using a microscope Olympus CX23 (Japan). To determine haematocrit, blood was pre-centrifuged on a CritSpin haematocrit centrifuge (USA). Biochemical parameters in blood serum were determined on a Chemray-240 analyser (PRC). The results were statistically processed in Microsoft Excel programme.

3 Results and discussion

We found that quails of control and experimental groups had good appetite, reacted to stimuli, looked healthy, droppings of birds in all groups had characteristic colour and consistency, no clinical signs of digestive disorders were found. The use of extruded lupine seeds in quail feeding had a positive effect on zootechnical parameters of productivity (Table 1).

Table 1. Quail persistence, growth and feed costs

Indicator	I group	II group
Number of quails at the beginning of the experiment, number of birds.	80	80
At the end of the experiment, number of birds.	80	80
Preservation %	100	100
Live weight at the beginning of the experiment, g	49.95±0,78	50.16±0,56
At the end of the experiment, g	273.09±1.96	280.10±2.37*
Live weight gain of quails, g	223.14	229.92
Average daily live weight gain of quails, g	5,87	6,05
Feed costs per 1 kg of gain, kg	1.77	1.71

* – $p \geq 0.05$ the difference between the lowest and the target value

Table 1 shows that quails receiving extruded lupine had slightly higher growth energy and live weight. Average daily weight gain of quails of the control (first group) was 5.87 g, and in the experimental (second group) was 3.1% higher and was 6.05 g. Live weight of birds of the second group was higher than the first group by 7.01 g or 2.3% and was 280.1±2.37 g by the end of the experiment, while in the control it was 273.09±1.96 g ($p \geq 0.05$).

Live weight of quails receiving extruded soya with mixed feed was 85.07±1.22 g at the age of 17 days, 110.19±1.23 g at the age of 24 days, 142.18±1.71 g at the age of 32 days, 207.86±1.37 g at the age of 40 days and 273.09±1.95 g at the age of 48 days. In the second group live weight of birds was 85. 25±1.27 g, 24 days - 118.86±1.38 g, 32 days - 147.68±1.87 g, 40 days - 215.41±2.99 g, 48 days - 280.10±2.37 g. It should be noted that this indicator in birds of the second group was higher at the age of 17 days - by 2.6%, 24 days - by 7.8%, 32 days - by 3.9%, 40 days - by 3.6%, 48 days - by 2.6%.

Inclusion of lupine in the composition of the diet allowed to reduce feed costs per 1 kg of live weight gain of birds by 3.4%.

The study of basic morpho-biochemical indices of blood is an important indicator of evaluation of the state of the internal environment of the organism, the course of metabolic processes, its main factors of immunity and metabolism. Morphological blood parameters of experimental quails are presented in Table 2.

Table 2. Morphological indices of quail blood

Indicator	I group	II group
Haemoglobin, g/l	123.8±2.87	135.2±2.05*
Haematocrit, %	41.54±1.26	50.64±3.36*
Red blood cell count (RBC), 10^{12}/L	2.78±0.57	2.86±0.15
Mean erythrocyte volume (MCV), pccl	152.82±13.20	180.48±19.77
White blood cell count (WBC), 10^{9}/L	2.91±0.23	5.63±0.76**
Platelets, thousand µl	58.6±13.07	65.4±7.21

Table 3. Biochemical parameters of quail blood

Indicator	I group (n=5)	II group (n=5)
Total protein, g/l	36.6±1.01	35.98±0.78
Albumin, g/l	23.42±1.04	23.58±0.49
Glucose, mmol/l	15.8±0.94	15.16±0.87
Urea, mmol/l	1.48±0.42	1.30±0.14
Cholesterol, mmol/l	6.23±0.74	5.84±0.45
Triglycerides, mmol/l	4.17±1.98	2.45±1.15
Alkaline phosphatase (alkaline phosphatase), U/L	846.4±26.40	713.2±15.80**
Aspartataminotransferase (AST), units/L	248.56±11.06	204.28±10.04*
Alanine aminotransferase (ALT), units/L	24.80±0.66	6.36±0.27***
Gamma- glutamyltranspeptidase (GGT), units/litre	4.60±0.41	1.86±0.82**
Uric acid, µmol/L	394.2±40.01	362.74±29.29
Creatinine, µmol/L	70.4±0.68	57.60±1.07***
Total bilirubin, µmol/l	8.1±0.51	2.68±0.33***
Calcium, µmol/l	2.96±1.00	2.92±0.52
Phosphorus, µmol/l	2.21±0.58	2.69±0.31

*$p \geq 0.05$; **$p \geq 0.01$; ***$p \geq 0.001$ the difference between the lowest and the target value

It follows from the data of Table 2 that in the second group of quails in the blood there were higher indicators of haemoglobin content by 9.8% and haematocrit level by 21.8%, which indicates the activation of haemopoiesis process, improvement of protein and oxygen supply of blood cells. This fact is also confirmed by the increase in the number and volume of erythrocytes [21]. Thus, in the blood of quails of the control group the number of erythrocytes was 2.78×1012/l, and in the blood of birds of the experimental group - 2.86×1012/l. Also within the physiological norms for synanthropic birds there was a slight increase in leukocytes and thrombocytes. The obtained data are confirmed by other authors who studied haematological parameters of quails [22].

Analysing blood serum parameters (Table 3), it should be noted that the amount of protein, albumin, glucose, urea, calcium and phosphorus in experimental quails was approximately at the same level. In quails of the second group some decrease in cholesterol, triglycerides and uric acid was observed.

The activity of such transaminases as alkaline phosphate, ALT, AST, GGT characterise the state of amino acid and protein metabolism, as well as the functional work of the liver. In our studies in blood serum of birds of the experimental group these indices

were significantly lower: ALT by 18.6% (p≥0.01), ALT by 74.3% (p≥0.001), AST by 17.8% (p≥0.05), GGT by 59.6% (p≥0.01).

4 Conclusion

The results of the conducted experiment showed that inclusion of ground extruded white lupine seeds in the feed mixture for young quails instead of extruded soybean does not have a negative effect on physiological condition. promotes an increase in body weight of quails by 2.6% (p≥0.05), and a decrease in feed cost by 3.4%.

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