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USE OF FULL-FAT SOY FLOUR IN COMPOUND FEEDS FOR MEAT CHICKENS OF THE INITIAL LINES AND BROILER CHICKENS

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ABSTRACT

The article presents the results of studies on the use of full-fat soy flour in compound feeds for meat chickens of the three source lines and broiler chickens of the selection SSC "Smena". The studies were carried out on three initial lines of the bird: B6 - the maternal line of the paternal parent form of the Cornish breed, fast-growing, fast-changing. The main breeding traits are growth rate, feed conversion, meat quality, egg production; B7 - paternal line of the maternal parent form of the Plymutrok breed, fast-fledged, breeding by egg production, hatchability, growth rate, feed conversion, viability; B8 is the paternal line of the maternal parent form of the Plymutrok breed, which is slowly changing and is selected for egg production, hatchability, growth rate, feed conversion, and viability. It has been established that 10% can be included in compound feeds for meat chickens, broilers 15% soy flour, provided that they are balanced in nutrients.

Disciplinary: Animal Sciences (Poultry Science, Animal Nutrition and Feed Technology), Biotechnology.

1. INTRODUCTION

Soybean seeds processed by Russian oil and fat enterprises occupy second place after sunflower in the total amount of oilseeds. Their uniqueness is due to the possibility of simultaneously producing high-quality vegetable oil and high-protein meal and meal that can be used in the production of feed and serve as raw materials for the development of a wide range of food protein products - various types of soy flour, isolates, protein concentrates, as well as textured soy proteins. Soybean seeds also produce milk, tofu, miso, various sauces and other types of soy products, the interest in which in Russia in recent years has grown significantly (Arkhipov, 2007).

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The leading countries in the field of industrial technologies for soybean processing are the USA and China. Russia also has experience in the processing of soybean; equipment has been developed for the production of soybean oil and protein products for food and feeds purposes (Domoroschenkova, 2012). The shelf life of soybean meal is short, so it is more profitable to purchase soybeans and process them at Russian oil and fat plants.

Soybeans contain up to 45% protein with a high level of essential amino acids, including lysine, threonine, tryptophan, as well as 13–20% vegetable fat. Soybeans are not used in the feeding of poultry in its natural form due to the presence of anti-nutritional substances in them that inhibit trypsin activity, reduce feed efficiency or have a toxic effect. Raw soybeans contain about 20 mg / g trypsin inhibitor (at a maximum allowable concentration of 4.5 mg / g), as well as lipoxidase, hemagglutinins, and allergens. All of them are protein compounds, which under certain processing conditions undergo denaturation, and their activity decreases to a safe level (Fisinin, et al. 2000).

The quality of soy protein meets the most demanding requirements: it is easily digested (86–98% depending on the type of product) and contains a set of all essential amino acids. The composition of proteins in soybean seeds varies significantly depending on the varieties and growing conditions. Soy protein improves the total amount of dietary protein when used in combination with other low-value cereals.

Toasted non-fat soya is a high-energy supplement to animal feed due to its high content of fat-rich in lecithin, plant steroids, and unsaturated fatty acids. It favorably combines starch and sugar, there are vitamins of groups B, C, and E, provitamin A. It is not inferior to highly valuable proteins of animal origin in the digestibility of iron. Also, soybean oil contains up to 55% linoleic acid, which is limiting (Mikhailova, et al. 2014). Toasted soybeans contain an average of 40% crude protein, 20% fat, and 7% crude fiber.

From the economy, full-fat toasted soy is not inferior to soybean meal and oilcake traditionally used in feeding and even surpasses them. If we take into account the greater energy value and lower production costs, then it has undeniable advantages. The low risk of compound feeds for poultry containing this product is also important because of the lower bacterial contamination due to the rejection of the use of animal products; improving their taste thanks to fried soybeans and reducing the intake of oils and fats. Soy products in the form of meal, oil, and flour are widely used in the feeding of farm animals and poultry (Egorova, et al. 2019).

In recent years, there has been an intensive study of full-fat soy flour as a source of essential amino acids, fatty acids, and energy when growing broiler chickens, as well as in the diets of breeding birds.

The purpose of this work is to study the effectiveness of using full-fat soy flour in compound feeds for meat chickens of the three source lines B6, B7 and B8, and broiler chickens.

2. METHOD

The studies were carried out on three initial lines of the bird: B6 - the maternal line of the paternal parent form of the Cornish breed, fast-growing, fast-changing. The main breeding traits are growth rate, feed conversion, meat quality, egg production; B7 - paternal line of the maternal parent form of the Plymutrok breed, fast-fledged, breeding by egg production, hatchability, growth rate, feed conversion, viability; B8 is the paternal line of the maternal parent form of the Plymutrok breed,

which is slowly changing and is selected for egg production, hatchability, growth rate, feed conversion, and viability (Egorova, 2018).

The studies determined the effect of full-fat soy flour in animal feed from plant components on the zootechnical parameters of broiler chickens and meat chickens of the initial lines B6 (Cornish breed), B7 (Plymouth breed) and B8 (Plymouth breed), and also evaluated blood biochemical parameters. To achieve this goal, zootechnical and physiological experiments were conducted under the conditions of the FSBI SGC "Zagorsk EPH" VNITIP.

The chickens were kept in special cages of 25 animals in a group from 21 to 62 weeks old; broiler chickens were raised in Big Dutchman type cell batteries from daily to 35 days of age. The light, temperature and humidity conditions, the front of feeding and watering were by the recommendations of VNITIP (2015). The bird was fed with loose feed with nutrition according to the standards of VNITIP (2018). The level of exchange energy in feed for broiler chickens up to 21 days of age was 12.98 MJ/kg; for 22-28 days 13.19 MJ/kg and from 29 days to slaughter 13.4 MJ/kg with a crude protein level of 23, 21, 20, respectively, and the fiber level was in the range of 3.7–4.2%.

The norm of compound feed for meat chickens, taking into account live weight 147–162g per day per 1 goal, with a metabolic energy level of 11.3 MJ/kg up to 49 weeks and 11.1 MJ/kg from the 50th week with a crude protein level of 17.0 and 16.0%, respectively, age. When preparing recipes for compound feeds, the normalization of amino acids was carried out taking into account their digestibility, and all vitamins and minerals were introduced into compound feeds through a 1% premix. The experiments on broiler chickens and meat chickens were carried out according to the scheme shown in Table 1.

Table 1: Scheme of the experiment on broilers and meat chickens

Group	Feeding Features *
1st - control	The main diet (OR), balanced in all nutrients, by the norms of VNITIP
2nd - experienced	OR with the inclusion of 15% full-fat soy flour for broiler chickens and 10% for chickens to replace part of soybean meal and sunflower oil **.

* the experiment was carried out according to a single scheme for chicken lines B6, B7 and B8, and rational levels of input of full-fat soy flour in mixed feeds were determined in previous studies;
** Sunflower oil was not added to the diet of laying hens of the experimental group.

The study took into account the following indicators: the chemical composition of full-fat soy flour; preservation of livestock by accounting for waste and establishing its causes; live weight of broilers at the age of 1, 21 days and 35 days, and chickens at 21 and 62 weeks by individually weighing the entire population in groups; average daily gain in live weight. Also, the cost of feed per 1 kg of gain in live weight was taken into account at the end of the experiment; feed consumption for the entire growing period (1 kg per 1 goal); the digestibility and use by birds of the main nutrients of compound feed according to the results of physiological experience at the age of 30–35 days; the chemical composition of broiler pectoral muscles at the end of cultivation, egg-laying on the initial laying layer in 62 weeks, egg mass at 30 weeks of age, and incubation egg yield.

3. RESULT AND DISCUSSION

An analysis of the chemical composition of full-fat soy flour showed that its crude protein content was 34.5% at a level of crude fat of 17.4%, crude fiber 6.80%, calcium 3.95% and phosphorus

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0.67%. The exchange energy was at the level of 14.65 MJ/kg. By the content of crude protein, full-fat soybean meal was 7.7% less than soybean meal, and by 39.84% and 4.10 MJ/kg in terms of fat and metabolic energy, respectively. The chemical composition of full-fat soy flour is presented in Table. 2. Table 3 gives the content of polyunsaturated fatty acids in soybean oil was significantly higher than in beef fat.

Table 2: The chemical composition of full-fat soy flour, flakes, and meal.

Indicator	Full Fat Soya Meal	Soybean flakes	Soybean meal
Moisture, %	9.92	9.28	10.11
Exchange energy, MJ/kg	14.39	10.29	11.07
Crude protein, %	35.1	48.8	35.4
Fat, %	18.04	1.35	6.01
Crude fiber, %	7.29	7.57	7.35
Linoleic acid, %	8.33	0.61	3.02
Ash, %	4.35	7.02	6.85
Calcium, %	0.22	0.40	0.37
Phosphorus, %	0.65	0.64	0.62
Total acidity, oN	5.02	5.77	6.44
Peroxide value, mol 1/2/0	0.37	0.41	0.49
Toxicity, %	Nontoxic	Nontoxic	Nontoxic
Amino acids, %:			
lysine	1.82	2.69	2.19
histidine	1.07	1.20	0.99
arginine	2.77	3.44	2.57
Aspartic acid, %	2.20	3.25	3.04
Threonine, %	1.47	1.69	1.61
Serine, %	1.35	1.80	1.47
Glutamic acid, %	10.62	9.04	9.01
Proline, %	1.51	1.84	1.59
Glycine, %	1.95	1.99	1.54
Alanine, %	1.90	1.81	1.74
Cystine, %	0.49	0.64	0.52
Valin, %	1.65	1.99	1.90
Methionine, %	0.48	0.62	0.45
Isoleucine, %	1.50	1.72	1.70
Leucine, %	2.66	2.77	2.81
Tyrosine, %	1.42	1.60	1.40
Phenylalanine, %	2.02	2.20	2.12
Urease activity, pH	0.24	0.17	0.20
Soluble protein, %	79	77	75

Table 3: Fatty Acid Composition of Soybean Oil and Beef Fat

Indicator	Soybean oil	Beef fat
Palmitic, %	11.01	29.70
Stearic, %	4.44	14.92
Oleic, %	24.02	39.01
Linoleic, %	54.45	2.69
Linolenic, %	8.29	0.47
Tocopherols, mcg/g:		
α	140	–
β	25	–
γ	710	–
δ	305	–

The main fatty acids that enter the body of a bird with soybean oil are p-6 and p-3 polyunsaturated fatty acids, cis and trans isomers of monounsaturated fatty acids. Each category of these fatty acids has a significant effect on lipid metabolism and the degree to which fats are

consumed by the body.

Zootechnical indicators obtained in the experiment on broilers are presented in Table. 4.

Table 4: Zootechnical indicators in the experiment on broiler chickens.

Indicators	Group	
	1	2
Preservation, %	100.0	100.0
Average live weight, g: 1 day.	42.9 ±0.10	43.2 ±0.11
4 days	91.4 ±0.36	93.4 ±0.42
7 days	144.2±1.41	151.3±1.35
14 days	407.5±5.02	439.2±6.01
21 days	820.5±12.5	867.0 ±16.4
35 days., G (on average), including	1975.7	2064.9
cockerels	2134.7±35.4	2220.9±37.5
chickens	1816.7±31.1	1908.9±32.3*
The average daily gain in live weight, g	55.22	57.76
Feed intake 1 goal., Kg, for 35 days	3.047	2.992
The cost of feed per 1 kg of increase in live weight, kg, for 35 days	1.542	1.480
Slaughter yield, %	72.3	72.5

* P≤0,05.

According to Table. 4, the introduction of full-fat soy flour in an amount of 15% in the diets of broilers provides 100% safety of young animals. The live weight of broilers in the experimental group at 21 days of age was 867.0 g; in the 35-day-old - 2064.9 g, which is higher than the control bird by 5.7 and 4.5%, respectively, of the age periods. At the age of 35 days, the live weight of the hens in the experimental group was 5.1% higher (P≤0.05), and the males were 4.0% higher than the control group. The research results showed that males and hens reacted almost equally (in terms of live weight) to the inclusion of full-fat soy flour in mixed feeds.

When using 15% full-fat soy flour in broiler diets, the average daily gain in live weight was higher than the control by 5.0%. The large live weight of the experimental young by the end of the cultivation provided a high feed conversion. Feed costs per 1 kg of live weight gain in the experimental group amounted to 1.480 kg and were lower than in the control group by 4.0%.

Table 5 presents the main indicators of digestibility and use of feed nutrients.

Table 5: Key indicators of digestibility and nutrient utilization of feed in broiler chickens aged 30-35 days

Indicators	Group	
	1	2
Digestibility, %: dry matter	70.88±0.17	72.14±0.14***
protein	91.77±0.22	93.37±0.30*
The use of nitrogen, %	62.40±0.15	63.27±0.14**
Availability, %:		
lysine	82.7±0.27	82.9±0.25
methionine	80.4±0.22	81.7±0.24*
Digestibility of fat, %	71.21±0.31	75.07±0.20***
Use, %:		
calcium	36.3±0.21	37.9±0.22
phosphorus	56.5±0.17	56.4±0.19

* P≤0,05; ** P≤0,01; *** P≤0,001.

The digestibility of dry matter and protein in the experimental group of chickens, which were

obtained in the feed composition of 15% full-fat soy flour, was 72.14 and 93.37%, which is 1.26 and 1.60% higher than the control (P≤0.001 and P≤ 0.05). The use of feed nitrogen in the experimental group was higher by 0.87% compared with the control group (P≤0.05). The availability of lysine and methionine from experimental feed was 82.9 and 81.7%. The digestibility of fat from animal feed containing 15% full-fat soy flour in broilers of the experimental group was at the level of 75.07%, exceeding the control by 3.86% (P≤0.001). The use of calcium and phosphorus by experienced broilers practically did not differ from the control.

When using full-fat soy flour in animal feed in experimental young animals, there was a tendency to increase the level of protein in the pectoral muscles, compared with the bird of the control group by 0.4%. The content of fat and ash in the pectoral muscles of the experimental and control groups was practically the same. There were no significant differences in the content of dry matter broilers in the pectoral muscle.

In the experiment on laying hens of the initial lines B6, B7, and B8, it was found that the safety of the livestock for the period of 21–62 weeks was at the level of 100% (Table 6).

Table 6: Zootechnical indicators of meat chickens of the initial lines B6, B7 and B8 for 21–62 weeks

Indicators	Б6		Б7		Б8	
	1st group	2nd group	1st group	2nd group	1st group	2nd group
The safety of the livestock, %	100.0	100.0	100.0	100.0	100.0	100.0
Live weight g:						
at the beginning of the experiment (21 weeks)	2408±34.5	2420± 31.1	2281± 32.4	2297± 39.2	2275± 31.4	2281± 37.7
at the end of the experiment (62 weeks)	4490±45.0	4501± 38.2	4025± 40.7	4030± 43.4	4037± 45.5	4040± 38.4
Egg production for the initial laying hen in 62 weeks, pcs.	118	120	158	161	157	160
The mass of eggs at 30 weeks of age, g	62.3±0.19	62.4± 0.21	60.6± 0.20	60.8± 0.24	60.2± 0.23	60.4± 0.24
The output of hatching eggs, %	91.2	91.8	93.4	93.6	93.3	93.5

Studies on the baseline lines of meat chickens showed that replacing soybean meal with full-fat soy flour with the exclusion of vegetable oil from animal feed made it possible to ensure high productivity of the experimental poultry. Egg production for the initial laying hen for 62 weeks along the B6 line in the experimental group was 120 eggs, in the control - 118; along the B7 line - 161, in the control - 158; along the line B8 - 160 eggs, in the control - 157. According to the mass of eggs on each line at 30 weeks of age, no significant differences were found between the control and experimental birds. The yield of hatching eggs along line B6 was 90.2 and 91.8%; along the line B7 - 93.4% and 93.6% and along the line B8 - 93.5% in the control and experimental groups. Thus, full-fat soy flour is a valuable protein and energy product. It contains 14.39 MJ of metabolic energy per 1 kg, 35.1% of crude protein, 18.04% of crude fat.

4. CONCLUSION

This study showed that the inclusion of 15% full-fat soy flour in mixed feed broilers and 10% in mixed feed chickens of the original lines B6, B7 and B8 with a balanced feed for amino acids and other nutrients makes it possible to obtain high zootechnical indicators.

5. AVAILABILITY OF DATA AND MATERIAL

Data can be made available by contacting the corresponding authors

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