Efficiency of using high-protein soybean meal in feeding broilers of cross-breed ROSS-PM3

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Abstract. The use of high-protein soybean meal in broiler diets provided for 38 days of fattening obtaining live weight of 2,336 g, average daily gain in live weight of 60.4 g, which is higher than in the control group by 135 g and 3.5 g, respectively. The highest rates were observed in chickens that consumed compound feed with high protein soybean meal, which was characterized by a high content of crude protein (47.0%) and good protein solubility (77.8%). It is proved that the use of soybean meal with a high content of SP - 47.0% versus 42.0%, increases the live weight of chickens and reduces feed costs per 1 kilo of live weight gain.

1 Introduction

To actualize the genetic potential of modern broiler crosses, more and more demands are placed on the quality of the components that make up the compound feed [1–4]. The leading place among them is occupied by soy and sunflower meal.

The richest sources of essential amino acids, of course, are animal sources of protein. Today, the production of animal and vegetable proteins is 68 million tons per year, including 5.3 million tons of animal protein [5].

Due to the high price, components for the preparation of animal feed with animal protein are very often falsified, so in practice most diets for poultry, especially parent flocks, are composed mainly of plant sources of protein. The biological value of such diets is increased by enrichment with synthetic amino acids [6,7].

Protein of animal origin is more complete due to the wide variety and better ratio of amino acids, their greater bioavailability compared to protein of plant origin, but it is more scarce and expensive.

At present, quite a lot of research has been carried out to study the feeding of poultry by various diets in order to reduce, up to the complete exclusion, protein of animal origin and replace it with vegetable, provided that the biological value of the diets is preserved [8–10].

However, the question of optimal sources of vegetable protein in diets for broiler chickens is not well understood. Therefore, the study of this issue is relevant and important in theoretical and practical terms.

The purpose of these studies was to study the zootechnical and economic indicators of broiler chickens growing when they are fed compound feed with high protein soybean meal produced by Sodruzhestvo LLC, and its comparative assessment with a meal from another manufacturer.

The content of crude protein in the meal of LLC Sodruzhestvo was 47.0%, in the meal of LLC Ussuriysk it was 42.0%.

2 Materials and methods

The studies were carried out in 2018 in the conditions of JSC “Lindovskaya Poultry Factory - Breeding Plant” on broilers of the ROSS-PM3 cross from Day 1 to Day 38 of fattening.

The birds were kept in the same type of housing with equipment for feeding broilers in Russian-made cages 2B-3. The temperature and humidity conditions, the front of feeding, watering, and also the bird density were the same in the control and experimental groups and corresponded to the recommendations of VNITIP and manufacturers of the ROSS PM3 cross [11].

In four experimental groups there were 70347 goals, and in four control groups - 70208 heads of broiler chickens. Broilers were fed granular compound feed with nutritional value according to the norms of the cross-poultry feed manufacturer. Up to 10 days of age, broilers consumed starter feed, from 11 to 24 days - a grower, then up to 38 days - a finisher. The experimental design is presented in Table 1.

The diet composition of the experimental and control groups is presented in Table 2.
### Table 1. Experiment design.

| Group          | Feeding Features                                                                 |
|----------------|----------------------------------------------------------------------------------|
| Control        | The main ration with the introduction of soybean meal produced by Ussuriysk LLC  |
|                | Primorsky Krai                                                                    |
| Experimental   | The main ration with the introduction of soybean meal produced by LLC Sodruzhestvo |
|                | Kaliningrad                                                                       |

### Table 2. The composition of the rations for the experimental and control groups of broilers

| The composition of the feed | Experimental (The main ration with the introduction of soybean meal produced by Sodruzhestvo LLC, Kaliningrad), % | Control (the main ration with the introduction of soybean meal produced by Ussuriysk LLC, Primorsky Krai), % |
|-----------------------------|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Wheat                       | starter 45.11, grower 65.19, finisher 70.40                                                                  | starter 45.02, grower 64.08, finisher 70.23                                                                  |
| Corn                        | 15.00                                                                                                         | 15.00                                                                                                         |
| Soybean meal                | starter 31.10, grower 14.30, finisher 5.50                                                                   | starter 36.20, grower 16.50, finisher 6.00                                                                   |
| Sunflower meal              | -                                                               | -                                                               |
| Bone flour                  | starter 3.0, grower 5.50, finisher 6.00                                                                        | starter 3.0, grower 5.00, finisher 5.50                                                                        |
| Sunflower oil               | starter 2.8, grower 3.60, finisher 3.90                                                                         | starter 3.3, grower 2.70, finisher 3.70                                                                         |
| Fodder yeast                | -                                                               | -                                                               |
| Lysine                      | starter 0.06, grower 0.05, finisher 0.10                                                                         | starter 0.08, grower 0.08, finisher 0.15                                                                         |
| Methionine                  | starter 0.01, grower 0.03                                                                                       | starter 0.02, grower 0.05, finisher 0.03                                                                                       |
| Threonine                   | starter 0.04, grower 0.06, finisher 0.06                                                                          | starter 0.05, grower 0.07, finisher 0.07                                                                          |
| Monocalcium phosphate       | starter 0.60                                                                                                                                                       |
| Defluorinated Phosphate     | -                                                               | -                                                               |
| Salt                        | starter 0.15, grower 0.01, finisher 0.03                                                                        | starter 0.14, grower 0.02, finisher 0.01                                                                        |
| Sodium bicarbonate          | starter 0.05, grower 0.10, finisher 0.20                                                                        | starter 0.11, grower 0.10, finisher 0.20                                                                        |
| Sodium sulfate anhydrous    | starter 0.19, grower 0.2, finisher 0.20                                                                         | starter 0.15, grower 0.20, finisher 0.20                                                                         |
| Limestone flour             | starter 0.29, grower 0.15                                                                                     | starter 0.30, grower 0.10, finisher 0.20                                                                     |
| Toxout+                     | starter 0.10                                                                                                   | starter 0.10                                                                                                   |
| Potassium carbonate         | -                                                               | -                                                               |
| Mineral mixture             | starter - 0.02                                                                                                  | starter - 0.02                                                                                                  |
| Premix 13455                | starter 1.50                                                                                                   | starter 1.50                                                                                                   |
| Premix 09258                | starter 1.50                                                                                                   | starter 1.50                                                                                                   |
| Premix 09259                | -                                                               | -                                                               |
| Total                       | 100                                                                                                           | 100                                                                                                           |

### 3 Results

High protein soybean meal produced by Sodruzhestvo LLC contains 47.0% crude protein, 4.1% crude fiber, 2.1% crude fat (Table 3.) No GMO was found in the meal sample. Soybean meal produced in Ussuriysk contained: 42.0% crude protein, 5.0% crude fiber, 1.9% crude fat. Feeding chickens up to 10 days of age of high protein soybean meal as part of the starter contributed to an increase in their live weight by 1.9%. At 24 days and 38 days of age - by 4.8% and 6.1%, respectively.

When using high-protein soybean meal in the experimental group, the average daily gain in live weight was 60.4 g in total, and was higher than the control by 6.1%. The increased increase in live weight ensured its best conversion. For the entire period of fattening, the cost of feed per 1 kg of increase in live weight in the experimental groups was 1.80 kg, and in the control - 1.87 (or which is 3.9% less than in the control).

### Table 3. The chemical composition of soybean meal.

| Chemical composition of soybean meal | Experimental group | Control group |
|-------------------------------------|--------------------|---------------|
| Moisture content, %                 | 11.5               | 11.6          |
| Crude protein,%                     | 47.0               | 42.0          |
| Crude fiber,%                       | 4.1                | 5.0           |
| Crude fat,%                         | 2.1                | 1.9           |
| Soluble protein, %                  | 77.8               | 73.2          |
| Urease                              | 0.08               | 0.09          |
| Lysine                              | 2.66               | 2.42          |
| Methionine                          | 0.57               | 0.53          |
| Methionine cystine +                | 1.15               | 1.08          |
| Threonine                           | 1.56               | 1.43          |
The diets of the experimental and control groups were similar in composition, with the exception of soybean meal. Since a higher protein meal was used, this allowed to reduce the input as the meal itself - by 5.1% for the starter, by 2.2% for the grower and by 0.5% for the finisher, as well as the essential amino acids- lysine - by 33.0% for the starter, 60.0% for the grower and 50.0% for the finisher, methionine - 100, 66.6% for the starter and grower, respectively, threonine - 25.0% for the starter, 16, 6% - for grower and finisher. The composition of the diet for the control groups are shown in table 2.

Table 4. Nutrition of the diet for the experimental group of broilers receiving food with soybean meal (crude protein 47.0% Sodruzhestvo LLC, %)

| Feed Nutrition | Types of feed in different periods of fattening, % |
|----------------|-----------------------------------------------|
|                | starter | grower | finisher |
| Metabolic energy, kcal / 100g | 308    | 309    | 313    |
| Crude protein | 22.94  | 21.00  | 18.82  |
| Crude fat     | 5.07   | 6.17   | 6.51   |
| Crude fiber   | 3.19   | 4.17   | 4.22   |
| Linoleic acid | 2.52   | 2.83   | 3.02   |
| Lysine        | 1.43   | 1.31   | 1.16   |
| Methionine    | 0.71   | 0.65   | 0.60   |
| Methionine + cystine | 1.05 | 0.99 | 0.91 |
| Threonine     | 0.99   | 0.90   | 0.80   |
| Tryptophan    | 0.30   | 0.25   | 0.22   |
| Arginine      | 1.48   | 1.24   | 1.09   |
| Calcium       | 0.94   | 0.86   | 0.78   |
| Phosphorus    | 0.80   | 0.78   | 0.69   |
| Potassium     | 0.89   | 0.70   | 0.60   |
| Sodium        | 0.18   | 0.19   | 0.22   |

A decrease in the intake of soybean meal in the diet in the control group did not adversely affect its nutritional value. Nutritional rations for the experimental and control groups are given in tables 4 and 5, respectively.

Table 5. Nutrition of the diet for the control group of broilers receiving food with soybean meal SP 42.0% USURIISK, %

| Feed Nutrition | Types of feed in different periods of fattening, % |
|----------------|-----------------------------------------------|
|                | starter | grower | finisher |
| Metabolic energy, kcal / 100g | 300    | 309    | 313    |
| Crude protein | 22.88  | 21.00  | 18.87  |
| Crude fat     | 5.27   | 6.31   | 6.47   |
| Crude fiber   | 3.26   | 4.23   | 4.26   |
| Linoleic acid | 2.67   | 2.94   | 3.01   |
| Lysine        | 1.44   | 1.32   | 1.18   |
| Methionine    | 0.71   | 0.66   | 0.61   |
| Methionine + cystine | 1.05 | 0.99 | 0.92 |
| Threonine     | 0.99   | 0.90   | 0.79   |
| Tryptophan    | 0.29   | 0.24   | 0.20   |
| Arginine      | 1.45   | 1.27   | 1.08   |
| Calcium       | 0.97   | 0.87   | 0.73   |
| Phosphorus    | 0.83   | 0.78   | 0.71   |
| Potassium     | 0.96   | 0.70   | 0.62   |
| Sodium        | 0.18   | 0.19   | 0.19   |

Vitamins

| A, thousands of international units | 15 | 13.02 | 9.38 |
|-----------------------------------|----|-------|------|
| D₃, thousands of international units | 5.0 | 5.0 | 4.2 |

| E, mg | 100.0 | 93.38 | 56 |
| K, mg | 3.00  | 1.00  | 1.88 |
| B₁, mg | 3.00 | 2.01 | 1.88 |
| B₂, mg | 8.01 | 5.60 | 6.6 |
| B₃, mg | 15 | 9.34 | 9.34 |
| B₄, mg | 700.5 | 840 | 784 |
| B₅, mg | 60 | 37.38 | 37.38 |
| B₆, mg | 4 | 2.8 | 2.8 |
| B₁₂, mg | 0.021 | 0.014 | 0.014 |
| B₉, mg | 1.5 | 0.94 | 0.94 |
| H, mg | 0.02 | 0.22 | 0.14 |

Table 6 presents the zootechnical indicators of broiler fattening using high protein soybean meal.
Table 6. Zootecchnical indicators.

| Indicators                        | Experimental group | Mean   | Control group | Mean   |
|----------------------------------|--------------------|--------|---------------|--------|
|                                  | 1      | 2      | 3      | 4      |        | 5      | 6      | 7      | 8      |
| Type of housing                  | chicken cages     | chicken cages | chicken cages | chicken cages |        | chicken cages | chicken cages | chicken cages | chicken cages |
| Fattening, head                  | 15999  | 15972  | 19202  | 19174  | 17586  | 15239  | 20042  | 15443  | 19484  | 17552  |
| Density of landing head / m²     | 35.6   | 35.5   | 35.8   | 35.7   | 35.6   | 35.6   | 35.9   | 35.6   | 35.8   | 35.7   |
| Case,%                           | 1.90   | 1.70   | 1.60   | 1.80   | 1.75   | 1.70   | 2.30   | 1.50   | 2.20   | 1.93   |
| Culling%                         | 2.13   | 1.79   | 0.90   | 1.03   | 1.46   | 2.94   | 1.95   | 1.92   | 2.49   | 2.33   |
| Feeding period, days             | 38     | 38     | 38     | 38     | 38     | 38     | 38     | 38     | 38     | 38     |
| Net gain, kg                     | 35463  | 34417  | 43275  | 41834  | 354989 | 30492  | 41339  | 31683  | 57988  | 161502 |
| Live weight of 1 head of the main slaughter, g | 2345   | 2262   | 2404   | 2334   | 2336   | 2162   | 2213   | 2198   | 2231   | 2201   |
| The average daily increase in the main slaughter, g | 60.7   | 58.5   | 62.2   | 60.4   | 60.4   | 55.8   | 57.2   | 56.8   | 57.7   | 56.9   |
| Feed consumption per batch, kg   | 64420  | 62860  | 76100  | 74460  | 277840 | 57000  | 78386  | 57780  | 76370  | 269536 |
| The cost of all feed, rub        | 921653 | 903749 | 1082760| 1074354| 3982517| 820530 | 1125021| 829508 | 1096351| 3871411|
| Conversion                       | 1.82   | 1.83   | 1.76   | 1.78   | 1.80   | 1.87   | 1.90   | 1.82   | 1.88   | 1.87   |
| Feed price, excluding VAT rub / kg | 14.31  | 14.38  | 14.23  | 14.43  | 14.34  | 14.40  | 14.35  | 14.36  | 14.36  | 14.36  |
| The cost of feed per 1 kg of growth, rubles, without VAT | 26.04  | 26.31  | 25.04  | 25.68  | 25.77  | 26.92  | 27.27  | 26.13  | 26.99  | 26.83  |

4 Conclusion

Thus, the introduction into the broiler diets of high protein soybean meal produced by Sodruzhestvo LLC at all stages of feeding increases the productivity of the livestock, improves feed conversion and the use of nutrients. So, the live weight of broilers upon completion of fattening in the experimental group was higher than the control by an average of 135 g, while reducing feed costs by 70 g per 1 kg of gain in live weight. In addition, the introduction of this meal in broiler diets at different stages of fattening can reduce the input of synthetic amino acids into the diets.

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