The use of medicinal plants in the compound poultry feed

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Abstract. The experiments were carried out on 5 groups of cage housed broiler chickens of the Ross 308 cross aged from 1 to 35 days. It was found that dried chicory root, oregano, and common nettle are valuable additives in compound poultry feed. The addition of dried chicory root, oregano, and common nettle in amounts of 2 kg/t; 0.5 kg/t, and 2.0 kg/t, respectively, to broiler diets allows obtaining good livability (100%) and live bodyweight, as well as low feed conversion. In the experimental groups the dried medicinal plants were added to the feed without the use of in-feed antibiotics. It was statistically proven that the live bodyweight in broilers at the end of growing in the experimental groups was significantly in compare to control by 7.08-8.04%. This increase was accompanied by a decrease in feed conversion ratio by 10.33-10.45% due to improved digestibility and retention of dietary nutrients. With the introduction of dried medicinal plants into broiler feed, an increase in the protein content in the pectoral muscles by 1.31-1.56% and a decrease in fat content by 2.23-2.97% were found. The sensory quality of the roasted meat was good.

1 Introduction

The issues of providing the population with food products, in particular, high-value dietary meat, are being solved through the expanded production of broilers.

The broiler industry in all countries uses highly productive poultry of various crosses. The genetic potential of productivity of modern crosses of meat chickens is high: the average daily weight gain (ADWG) in broilers mounted to more than 60 g, feed conversion ratio (FCR) is 1.35-1.40 with the livestock livability during the growing period of 97-98%. The maximum use of the genetic potential of productivity in commercial conditions largely depends on the provision of poultry with nutrients and biologically active substances [1].

Most European countries have banned the use of the in-feed antibiotics in animal production. In this situation it is necessary to pay more attention to recipes for compound feeds for poultry, take care of the poultry health, and control the composition of the microflora of the gastrointestinal tract. Currently, of great importance is the selection of ingredients of compound feeds and feed additives that could replace antibiotics without significant changes in the composition of the diets.

A good diet containing a set of grain components, balanced in nutrients and biologically active substances, has a positive effect on the intestinal microflora, provides a high digestibility and assimilation of dietary nutrients.

The ban on in-feed antibiotics solves certain problems, but at the same time, others appear. After they were prohibited in some European countries manufacturers were faced with an increase in the incidence of necrotic enteritis, diarrhea, and other diseases. The animals were sick, their productivity decreased, FCR worsened, and as a result, the profitability of production began to fall [2,3].

In many countries alternative means of controlling intestinal microflora were put into practice, such as acidifiers, probiotics, enzymes, growth accelerators of beneficial microflora, and immunomodulators [4].

Feed additives prepared from medicinal plants are now of great interest.

Chicory is used in traditional medicine to treat various diseases, including high blood sugar [5-7]. In traditional Indian medicine Ayurvedic tonic made from chicory has been used to treat fever, diarrhea, and enlarged spleen. The leaf extract is widely used in the treatment of jaundice, enlarged liver, gout and rheumatism [8]. Modern studies have confirmed the antidiabetic, antihyperglycemic, wound healing and antioxidant effects of chicory [9-11], as well as antiulcer, anti-inflammatory, analgesic, hepatoprotective, hypoglycemic, diuretic, hypolipidemic, immunomodulatory properties [12-15] A wide spectrum of biological effects is a consequence of a rich biochemical composition, including alkaloids, inulin, sesquiterpene lactones, coumarins, vitamins, chlorophyll, unsaturated sterols, flavonoids, saponins, tannins, organic acids and polyphenols.

Dried oregano is used as a food spice. Oregano-based preparations have insecticidal, antifungal and antimicrobial properties. They improve appetite and activate enzymes, fight a large number of pathogens, both Gram-positive and Gram-negative.

Nettle is used for food, as well as in the treatment of rheumatism, gastrointestinal disorders, as a diuretic and hemostatic agent. Common nettle is rich in carotenoids, vitamins and trace elements [16]. Young common nettle

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Table 1. The scheme of the study.

Group	Amount of heads	Feeding features
1 control	35	Basic diet (BD) balanced in all nutrients in accordance with the norms of ARRTPI (2019), with the addition of antibiotic Bacitracin-30 (with an activity of 42 U/mg in an amount of 100 g/t feed)
2 experimental	35	BD without antibiotic, with addition of 2kg/t of dried chicory root
3 experimental	35	BD without antibiotic, with addition of 0.5 g/t of dried oregano
4 experimental	35	BD without antibiotic, with addition of 2kg/t of dried common nettle
5 experimental	35	BD without antibiotic and medicinal plants

leaves are used in salads, which have a number of benefits, such as low calorie content, the ability to regulate intestinal microflora, and a high content of biologically active substances.

The aim of this work is to study the effectiveness of the compound feeds for broiler chickens containing chicory, oregano, and common nettle in dry form instead of feed antibiotics.

2 Materials and methods

The studies were carried out at the Selection and Genetic Center "Zagorskoe Experimental Breeding Farm" of the Federal Scientific Center "All-Russian Research and Technological Poultry Institute" of Russian Academy of Sciences (ARRTPI) in 2020. The broilers of the Ross 308 cross housed in R-15 cage battery were studied, 35 heads in each group, aged from 1 to 35 days. The broilers were allotted to 5 groups by the method of random sampling.

Stocking density, light, temperature, humidity conditions, feeding and drinking in all age periods corresponded to the recommendations of ARRTPI ("Methodology for conducting scientific and industrial research on feeding poultry") and were the same for all groups.

The chicken was fed with compound poultry alluvial feeds with nutritional value according to ARRTPI standards, 2019. The feed scheme was as follows:

- 0 - 14 days - the compound poultry feed Starter;
- 15 - 21 days – the compound poultry feed Grower;
- 22 - 35 days – the compound poultry feed Finisher.

The level of metabolic energy in the compound poultry feed for broiler chickens up to 14 days of age was 12.98 MJ/kg; from 15 to 21 days of age - 13.19 and from 29 days to slaughter - 13.40 MJ/kg with a crude protein level of 23; 21 and 20%; calcium - 1.0; 0.9 & 0.9%, respectively; total phosphorus 0.7% and available phosphorus 0.4%; according to age periods the levels of fiber were in the range of 3.7-4.2%. Dried medicinal plants in the crushed form were mixed with crushed wheat and introduced into the compound feed. The scheme of the study is presented in table 1.

We examined the following parameters:

– Livability of livestock by accounting for mortality and establishing its causes,%;

– Live weight of broilers at the age of 1, 14, 21, and 35 days, g. It was assessed by individually weighing of the entire livestock in groups using the MT6B1DA electronic scale (2.230x230);

– Feed consumption, for the entire growing period, kg per head;

– FCR at the end of the experiment;

– Digestibility and retenttion of feed nutrients, according to the results of physiological trial at the age of 28-33 days;

– Hygroscopic moisture of feed, droppings, liver and pectoral muscles assessed by drying biological material at 100 °C to constant weight in accordance with the Russian State Standard GOST 13496.3-92;

– Total nitrogen content in feed, droppings, assessed by the Kjeldahl method using the automatic analyzer in accordance with the Russian State Standard GOST R51417-99, %;

– The content of crude fat in feed, droppings, liver and pectoral muscles, %. It was determined by the method of Rushkovsky in the Soxhlet apparatus according to the Russian State Standard GOST 13496.18-85;

– The content of raw ash in feed, droppings, liver and pectoral muscles by dry ashing of the sample,%;

– Nitrogen in the litter according to Dyakov;

– Chemical analysis of feed, droppings, liver and breast muscles of broilers according to the generally accepted methods of biochemical analysis;

– Dressing percentage, yield of pectoral muscles; %;

– Organoleptic assessment of fried broiler meat, scores (taste panel test, 5-score system).

All analyzes were carried out at the Testing Center of the Federal Research Center ARRTPI RAS.

Research materials were processed biometrically on a computer according to N.A. Plokhinsky using Microsoft Excel, which makes it possible to ensure the objectivity of the results obtained.

3 Results and discussion

Zootechnical indicators in the experiment on broiler chickens are presented in Table 2.

The presented data shows that the addition of dried chicory root, oregano, and common nettle in the amount of 2 kg/t; 0.5 kg/t, and 2.0 kg/t, respectively, ensures the livability of young stock at the level of 100%.

Table 2. Zootechnical indicators in the experiment on broiler chickens.

Indicatior	Group				
	1c	2	3	4	5
Livability, %	100.0	100.0	100.0	100.0	100.0
Average live bodyweight, g: 1 day of age	42.40 ±0.11	43.40 ±0.06	43.02 ±0.08	43.40 ±0.09	44.00 ±0.10
14 days	467±9.2	470±9.44	472±7.00	475±6.90	440±5.44
% of control	100.0	100.64	101.07	101.71	94.22
21 days	771 ±11.31	820** ±12.40	837*** ±11.52	840*** ±14.41	760 ±12.10
% of control	100.0	106.36	108.56	108.95	98.57
35 days (in average)	1991	2140	2151	2150	1850
% of control	100.0	107.48	108.04	107.99	92.92
Including: cockerels	2084 ±34.44	2249*** ±37.71	2254*** ±35.55	2260*** ±32.21	2007 ±33.74
% of control	100.0	107.92	108.16	108.45	96.31
pullets	1898 ±27.74	2031*** ±20.23	2048*** ±22.34	2040*** ±20.91	1693 ±29.47
% of control	100.0	107.01	107.90	107.48	89.20
Average daily weight gain, g	55.67	59.91	60.23	60.19	51.60
% of control	100.0	107.62	108.19	108.12	92.69
Feed consumption by 1 head, kg	3.264	3.150	3.177	3.160	3.077
% of control	100.0	96.51	97.33	96.81	94.27
Feed conversion ratio	1.675	1.502	1.507	1.500	1.704
% of control	100.0	89.67	89.97	89.55	101.73
Dressing percentage	70.85	72.01	71.97	72.70	70.87
Yield of pectoral muscles, %	24.05	24.42	25.01	25.20	23.01
** $P \leq 0.01$; *** $P \leq 0.001$					

The live bodyweights of broilers in experimental groups Nos. 2, 3 and 4 were 470-475g, 820-840 g, and 2140-2151 g at the 14th, 21st, and 35th days. These results exceeded the chicken weight in the control group for 0.64-1.71%, 6.36-8.56%, and 7.48-8.04%, respectively.

At the 35th day, the live weight in female broilers in the experimental groups was higher than that of the control group by 7.01 - 7.90%, in males by 7.92 - 8.45%. The results showed that cockerels better responded by an increase in bodyweight to the inclusion of medicinal plants into the diets as compared to pullets. The broilers of the experimental group No.5, who received the compound poultry feed without the addition of the feed antibiotic and medicinal plants, had lower live weight that that in the control group and experimental groups at all age periods.

When using dried chicory root, oregano, and common nettle in broiler diets in the amount of 2 kg/t; 0.5 kg/t, and 2.0 kg/t, the ADWG was 59.91-60.23 g. higher than that of the control chickens by 7.62-8.19%.

The higher live bodyweight of the chickens in experimental groups by the end of the growing provided a high FCR. For the entire growing period FCR in the experimental groups of chickens that additionally received dried medicinal plants were 1.500 - 1.507, lower than that in the control group by 10.03-10.49%. The highest FCR was found in group No.5 (1.704 versus 1.675 in control).

The key indicators of feed digestibility and nutrient assimilation are presented in table 3.

The protein digestibility in the experimental groups of chickens, which received dried medicinal plants as part of the compound poultry feed, was 89.4-90.0%, which was 1.5-2.1% higher than that in the control group.

The assimilation of dietary nitrogen in experimental groups Nos. 2, 3 and 4 was within the physiologically normal range for this age (51.8-52.1%) and did not differ significantly in the experimental groups, exceeding this parameter in control group by 1.2-1.5%.

The availability of lysine and methionine in experimental groups was 82.5-82.7% and 81.4-81.9%, respectively, higher than in control group by 1.0-1.2% for lysine and 1.0-1.5% for methionine.

The digestibility of fat from the experimental compound feeds with the addition of dried medicinal plants was 76.4-77.0% and this indicator was higher than that of the control group by 0.4-1.0%.

The utilization of calcium and phosphorus in experimental groups of broilers was also for 1.2-1.5% and 1.1-1.8% higher than in the control group. The broilers of the experimental group No.5 in terms of digestibility and the use of feed nutrients were slightly inferior to both the chickens of the control group and all experimental groups.

The dressing percentage in the control group was 70.85%, yield of the pectoral muscles 24.05%. In broilers of experimental groups Nos. 2, 3 and 4 dressing percentage was 71.97-72.70%, with the yield of the pectoral muscles of 24.42-25.20%. In broilers of experimental group No.5, these parameters were at the

Table 3. Key indicators of feed digestibility and nutrient assimilation in chickens - broilers aged 30 - 35 days, n=6.

Characteristics	Group				
	1c	2	3	4	5
Protein digestibility, %	87.9±0.39	90.0±0.44	89.7±0.42	89.4±0.40	87.8±0.34
Nitrogen assimilation, %	50.6±0.90	51.8±0.30	52.0±0.27	52.1±0.34	50.0±0.28
Availability, %: lyzine	81.5±0.31	82.7±0.35	82.6±0.40	82.5±0.37	80.3±0.35
methionine	80.4±0.40	81.9±0.44	81.7±0.43	81.4±0.42	79.0±0.43
Fat digestibility, %	76.0±0.29	76.4±0.37	76.9±0.40	77.0±0.34	75.3±0.37
Retention, %:					
calcium	45.6±0.23	46.8±0.20	47.0±0.24	47.1±0.21	44.0±0.20
phosphorous	37.9±0.29	39.0±0.30	39.3±0.31	39.7±0.27	37.5±0.20

Table 4. The chemical composition of the pectoral muscles of the 35-days broilers, % (in air-dry substance), n=6.

Component, %	Group				
	1 c	2	3	4	5
Dry matter	25.32±0,30	25.40±0.19	25.91±0.30	25.48±0.39	25.01±0.27
Protein	88.70±0,50	90.01±0.40	90.26±0.42	90.07±0.44	87.00±0.46
Fat	5.25±0.10	4.02±0.08	2.58±0.11	2.28±0.12	6.04±0.08
Ash	4.10±0.08	4.17±0.10	4.31±0.06	4.11±0.05	4.81±0.09

Table 5. Organoleptic assessment of fried meat, scores (out of 5).

Characteristics	Pectoral muscles					Leg muscles				
	1c	2	3	4	5	1c	2	3	4	5
Aroma	4.30	5.00	5.00	5.00	5.00	4.50	5.00	5.00	5.00	5.00
Taste	4.70	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Smoothness (stiffness)	4.50	4.90	4.90	5.00	5.00	5.00	4.67	5.00	5.00	5.00
Juiciness	4.30	4.70	4.70	4.40	5.00	4.70	5.00	5.00	5.00	4.50
Average	4.45	4.90	4.90	4.85	5.00	4.83	4.92	5.00	5.00	4.88

level of the control group or lower than for any of the experimental groups.

The chemical composition of the pectoral muscles of broiler chickens is presented in Table 4.

Based on the chemical composition of the pectoral muscles, we can say that when using dried chicory root, oregano, and common nettle in compound feeds for broilers, there was a tendency to an increase in the protein level in the pectoral muscles of chickens in the experimental group compared to that of the control group by 1.31-1.56% , while the level of fat was lower in the experimental groups by 2.23-2.97%.

The ash content in the pectoral muscles of the experimental and control groups remained practically unchanged.

When using dried medicinal plants in broiler diets, there was a tendency to increase the protein level in the liver of chickens by 1.50-1.82%, while the fat content decreased, and the ash level was not affected.

Organoleptic evaluation of roasted broiler meat showed no negative effect of the addition of dried chicory on the taste and other parameters of meat.

The organoleptic assessment of meat is presented in table 5.

Fried meat was rated on a 5-score scale using the following indicators: aroma, taste, smoothness (stiffness) and juiciness. The quality of fried meat in the experimental groups was assessed on average at 4.85-4.90 scores for the pectoral muscles and 4.92-5.00 for the leg muscles.

4 Conclusions

Thus, we have established that dried medicinal herbs - root chicory, oregano, and common nettle are valuable additives for poultry. Addition of these plants in the compound poultry feed in the amount of 2 kg/t; 0.5 kg/t and 2.0 kg/t in rations enables to obtain good livability (100%), live bodyweight, and low feed conversion ratio when growing broilers. Thus, the live bodyweight of 35-day-old broilers in the experimental groups with the addition of medicinal herbs to the compound feeds was higher than that of the control group by 7.08-8.04%, with a decrease in feed conversion ratio by 10.33-10.45%. Broilers who received the compound poultry feed without the addition of the in-feed antibiotic and dried medicinal plants at all age periods lagged behind the poultry of the control group and experimental groups in terms of live bodyweight.

The use of dried medicinal plants in broiler diets instead of corn, with the exclusion of in-feed antibiotics, provides an average daily gain in live weight at the level of 59.91-60.23, which is 7.6-8.19% higher than the control due to improved digestibility and utilization of nutrients from the compound feed.

With the introduction of dried plants into the compound poultry feed of broilers, an increase in the protein level in the pectoral muscles by 1.31–1.56% was noted, while the fat decreased by 2.23–2.97%. The roasted meat tasted good. The effectiveness of using

dried chicory root, oregano, and common nettle in broilers can be assessed by the cost of these additives.

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