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INFLUENCE OF DISTILLERS DRIED GRAINS WITH SOLUBLES ON QUAIL MEAT PRODUCTIVITY

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Abstract

One of the priority tasks of the agro-industrial complex in the modern world is to increase agricultural animal productivity and maximize the use of various processing byproducts in their feeding. Therefore, the experiment has been conducted to determine the influence of distillers dried grains with solubles as a part of feed mixtures on young quail meat productivity. To carry out the experiment, 5 groups, 100 quail heads in each, have been formed. Quails in the control group 1 did not receive distillers dried grains with solubles as a part of their feed mixture. Quails in the experimental groups 2, 3, 4 and 5 were fed by, respectively, 5%, 10%, 15%, and 20% of distillers dried grains with solubles in complex with feed mixture. The experiment lasted for 35 days. Due to the daily body weight (thereinafter – BW) gain in average for the entire farming period, quails in the experimental group 5 gave in to quails in the control group by 0.16 g or 2.5% ($P < 0.01$), while the experimental group 2 outweighed them by 0.09 g or 1.4%, group 3 – by 0.19 g or 3% ($P < 0.01$), group 4 – by 0.13 g or 2.1% ($P < 0.01$). The lowest feed consumption per 1 kg of quail weight gain was observed in the experimental group 3, that gave in to quails in the control group by 78 g or 2.4%. The experimental groups 2 and 4 had the same indicators, that gave in to quails in the control group by 31 g or 0.9%. And only the experimental group 5 consumed 61 g or 1.8% more feed per 1 kg of BW gain in comparison to the control group. Evaluation of slaughter characteristics in quails, by means of complete feed mixtures with different content of distillers dried grains with solubles, has shown that the experimental group quails achieved the highest indicators.

Keywords: Pharaoh breed quails, feed conversion, livestock retention, slaughter rates

INTRODUCTION

Every single day, humans need more food, including animal source foods, but the planet resources are limited. That is why the priority task of world agriculture today is to increase agricultural animal productivity and maximize the use of various processing byproducts in feeding.

Distillers dried grain with solubles is a byproduct of bioethanol fermentation, which uses the dry milling technology for starch-rich grain such as corn. This is an excellent feed ingredient for cattle diet. This fact has been proved by many scientific studies and significant practical experience of its use in feeding of farm animals (Gunn *et al.*, 2014; Masse *et al.*, 2014; Tangendjaja, 2013). Distillers dried grain with solubles is valued for its significant protein content, which makes it a desirable feed ingredient for dairy cows diet (Tangendjaja, 2013). With the use of distillers dried grain with solubles, cow feeding becomes significantly cheaper and the productivity increases.

Distillers dried grain with solubles (thereinafter – bard) is also widely used in diets for pigs, as it contains a sufficient amount of proteins (Park *et al.*, 2018; Rho *et al.*, 2018).

The bard contains all the nutrients of the original grain, their quantitative ratio is significantly different from the original, though.

On the minus side, energy nutrition of bard is lower comparing to cereals, but on the plus side, crude protein is 2.5 times higher, constituting a crude protein content of 26%.

The bard has more fiber (15.1%), fat (5.1%) and crude ash (4.6%) than grain. However, if this protein product is compared with oil meal and ground oil cake, it turns out that bard has an advantage over them, because it contains 2 times less fiber. It retains more than 18% starch and up to 4% sugar.

Bard concentrates almost all amino acids, including essential ones. The content of lysine, methionine, threonine in the dry fermentation residue increases more than 2.5–3 times compared to the original grain.

Recently, in Ukraine and around the world, a significant amount of research has been conducted on the feasibility of using various corn processing byproducts in feeding of farm animals, including poultry: gluten flour (Seyedi *et al.*, 2014), distillers dried grain with solubles (El-Abd *et al.*, 2017; Konca *et al.*, 2011; Schilling *et al.*, 2010; Shim *et al.*, 2018).

MATERIALS AND METHODS

The aim of the experiment was to study the influence of distillers dried grains with solubles on quail meat productivity. To carry out the experiment, 500 one-day old quails of the Pharaoh breed were selected. According to the analogy principle (by age and body weight), one control and four experimental groups of 100 heads in each were formed (Tab. I). The meat quail breed Pharaoh was developed by the American breeder A. Marsh. This is the first and the only pure meat breed, which is characterized by quite large carcasses suitable for culinary purposes.

The experiment lasted for 35 days and was divided into two periods (1st–21st days and 22nd–35th days) and 7 subperiods lasting 7 days each.

During the first experiment, quails were kept in single-tier battery cages. 25 heads were placed in each cage measuring 46 × 40 × 20 cm. Given that, the floor area per head was 73.6 cm^2. Cage frames provided a feeding front of at least 1.5 cm. Vacuum drinkers were used to water the quails.

In the period from 1 to 21 days, artificial heating of quails was used at the temperature of 32–36 °C, then the room temperature was 21–23 °C. The relative humidity at the rate 65–70%. 24/7 lighting was applied in the first 3 weeks after birth. Subsequently, the length of light period is reduced by 3 hours during the week and set to 12 hours per 24-hour period. The experimental quails were given complete feed mixture; the feed nutrition corresponded to the recommended standards according to the age of the birds. The feed mixtures had a different percentage of the distillers dried grain with solubles added, and each recipe corresponded to the feeding standards for meat quails, which were developed by the Poultry Research Institute of the Ukrainian Academy of Agrarian Sciences (Ryabokon *et al.*, 2005). The feed was given twice a day (in the morning and in the evening). Throughout the experiment, precise records of given feed and unconsumed residues were kept. In addition, the retention number of quails, their BW and growth, feed consumption per 1 kg of growth were recorded. At the end of the experiment, slaughter of experimental birds (4 heads from each group) was carried out and slaughter rates were studied. The slaughter was carried out by the method of decapitation.

The indicators to assess slaughter qualities of quails were the following:

- pre-slaughter weight – body weight of quails after 12-hour-fasting;
- ungutted carcass weight – carcass weight without blood and feathers;
- weight of half-gutted carcass – weight of carcass without blood, feathers and intestines;
- the weight of the gutted carcass – the weight of the carcass without blood, feathers, head, legs, wings on the elbow joint, intestines;
- weight of edible parts – the weight of all edible parts of gutted carcass;
- weight of internal fat.

The weight of slaughter products was determined using scales VLTK-500. On the basis of indicators for post-slaughter qualities of quails, indices of

I: *Scheme of the experiment*

Group	Number, heads of livestock	Age, days	
		1–21	22–35
		Distillers dried grains with solubles content in feed mixtures, %	
1 – control	100	-	-
2 – experimental	100	5	5
3 – experimental	100	10	10
4 – experimental	100	15	15
5 – experimental	100	20	20

meat qualities of carcasses were determined by the following:

- carcass meat – the ratio of the weight of all muscles to the weight of the gutted carcass, %;
- breast meat – the ratio of the pectoral muscles weight to the weight of the gutted carcass, %;
- leg meat – the ratio of the weight of leg muscles to the weight of the gutted carcass, %;
- yield of edible parts – the ratio of all muscles weight to the weight of ungutted carcass, %.

Feed mixtures were used to feed the experimental quails. Feed mixture recipes were composed in such a way that their nutritional value was the same. In this regard, the same set of ingredients (wheat, corn, barley, soybean meal, sunflower meal, distillers dried grains with solubles, sunflower oil, fish meal, gluten flour, blood flour, l-lysine, dl-methionine, monophonic salt, sodium chloride, mono-calcium phosphate, concentrate) was used, but in different proportions. Despite the slightly different composition of feed mixtures, their nutritional value was the same as shown in Tab. II.

Fluctuations in fat content were the most significant, as the use of significant amount of distillers dried grains with solubles into feed mixtures resulted in the need for more oil to balance the metabolic energy content.

The chemical composition of feed mixtures was carried out according to traditional methods:

- crude protein – using the Kjeldal method;
- crude fat – using the method of SV Rushkovsky, based on determining the amount of defatted

II: *Energy and nutrient content per 1 kg of quail feed*

Indicator	Quail group									
	1	2	3	4	5	1	2	3	4	5
	Quail age 1–21 days					Quail age 22 days and more				
ME, MJ/kg	12.55	12.54	12.53	12.53	12.54	12.55	12.55	12.56	12.57	12.55
Crude protein, %	28.0	28.0	28.0	28.0	28.0	20.5	20.5	20.5	20.5	20.5
Crude fat, %	5.0	5.6	5.6	5.6	5.6	5.3	5.3	5.4	5.9	6.4
Crude fiber, %	3.3	3.4	3.4	3.5	3.5	3.9	3.6	3.4	3.6	3.7
Lys, %	1.70	1.66	1.63	1.60	1.57	1.03	1.03	1.03	1.03	1.03
Met+Cys, %	1.02	1.01	1.03	1.04	1.05	0.83	0.83	0.83	0.83	0.83
Thr, %	1.09	1.10	1.10	1.10	1.10	0.76	0.75	0.75	0.77	0.76
Trp, %	0.32	0.31	0.31	0.30	0.29	0.21	0.21	0.20	0.19	0.19
Arg, %	1.30	1.27	1.21	1.15	1.10	0.88	0.82	0.78	0.75	0.71
Val, %	1.43	1.43	1.43	1.44	1.44	0.89	0.88	0.88	0.89	0.89
His, %	0.91	0.92	0.91	0.91	0.91	0.53	0.53	0.53	0.54	0.54
Gly, %	1.06	1.05	1.07	1.09	1.10	0.73	0.70	0.68	0.68	0.67
Ile, %	0.77	0.76	0.75	0.73	0.72	0.56	0.55	0.55	0.54	0.53
Leu, %	2.52	2.57	2.59	2.61	2.62	1.65	1.69	1.73	1.83	1.84
Phe, %	1.33	1.33	1.31	1.28	1.27	0.86	0.85	0.85	0.85	0.83
Tyr, %	0.83	0.83	0.82	0.81	0.80	0.56	0.57	0.57	0.58	0.57
Ca, %	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
P total, %	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Na, %	0.34	0.34	0.41	0.45	0.49	0.3	0.3	0.3	0.4	0.4
Cl, %	0.26	0.27	0.31	0.34	0.38	0.2	0.2	0.2	0.3	0.3
Cu, mg	122	122	122	121	121	121	121	120	120	120
Zn, mg	92	93	95	97	99	89	90	91	92	93
Mn, mg	14	14	13	13	13	13	13	14	11	12
Fe, mg	354	334	332	319	306	236	204	184	175	164

Biometric processing of data obtained during the research was performed using MS Excel 2013 software using built-in statistical functions. While processing the experimental data, the arithmetic mean (M), its error (± m) and the significance level (P) were calculated. To indicate the significance level of the probability criterion (P), the following symbols were used in the tables: * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$ compared with the 1st control group.

residue in the Soxhlet apparatus, using benzol as a solvent;
- crude fiber – using the method of Henneberg and Shtoman;
- amino acid content – using an automatic analyzer TTT 339 using cation exchange resin LG ANB with active group SO3;
- the content of mineral elements – by spectral analysis using energy-dispersion X-ray fluorescence spectrometer "ElvaX".

Biometric processing of data obtained during the research was performed using MS Excel 2013 software using built-in statistical functions. While processing the experimental data, the arithmetic mean (M), its error (± m) and the significance level (P) were calculated. To indicate the significance level of the probability criterion (P), the following symbols were used in the tables: * P < 0.05, ** P < 0.01, *** P < 0.001 compared with the 1st control group.

RESULTS

The main output of meat-type quails is the increase in BW (Tab. III). During the first week of life, quails of the experimental groups 2 and 5 made less progress comparing to the control group quails in terms of average daily weight gain, by 0.13 g and 0.19 g, which is 4.0% and 6.0%. During the same age period, quails of the experimental groups 3 and 4 outweighed control group quails by 0.06 g or 1.9% and 0.14 g or 4.4%.

During the third week of growing, the results of quails in the 5th group were lower compared to the control indicators over the daily body weight (BW) gain in average by 0.4 g or 5.0%. At the same time, animals of the 2nd, 3rd and 4th experimental groups, on the contrary, dominated over the control indicators by 0.55 g or 6.8% (P < 0.05), 0.50 g or 6.2% and 0.12 g or 1.5%.

Only quails of the 5th experimental group were inferior to the control indicators in terms of daily body weight (BW) gain in average by 0.17 g or 3.1% in the last week of breeding. Quails of the 2nd, 3rd and 4th experimental groups prevailed over this indicator by 0.24 g, 0.43 and 0.12 g which were 4.4%, 7.8 and 2.2%.

Thus, the daily body weight (BW) gain in average for the entire period of quails breeding of the 5th experimental group was inferior to control analogues by 0.16 g or 2.5% (P < 0.01), whereas the animals of the 2nd experimental group dominated them by 0.09 g or 1.4%, 3rd – by 0.19 g or 3% (P < 0.01), 4th – by 0.13 g or 2.1% (P < 0.01).

The feed consumption indicator is important because its impact on quail productivity is significant (Tab. IV).

Analyzing the average daily feed intake of quails in general for the entire period of the experiment

III: *Dynamics of daily body weight (BW) gain in average, g*

Age, days	Quail group				
	Control	Experimental			
	1	2	3	4	5
1–7	3.19 ± 0.090	3.06 ± 0.078	3.25 ± 0.081	3.33 ± 0.063	3.00 ± 0.076
8–14	6.91 ± 0.127	6.86 ± 0.090	6.91 ± 0.115	7.14 ± 0.150	6.93 ± 0.105
15–21	8.03 ± 0.167	8.58 ± 0.172*	8.53 ± 0.182	8.15 ± 0.185	7.63 ± 0.185
22–28	8.06 ± 0.207	7.93 ± 0.199	8.06 ± 0.204	8.13 ± 0.202	7.94 ± 0.218
29–35	5.48 ± 0.182	5.72 ± 0.191	5.91 ± 0.212	5.60 ± 0.242	5.31 ± 0.207
1–35	6.34 ± 0.035	6.43 ± 0.038**	6.53 ± 0.049**	6.47 ± 0.036**	6.18 ± 0.042**

Here and further * P < 0.05, ** P < 0.01

IV: *Average daily feed consumption, g/age/days*

Age, days	Quail group				
	Control	Experimental			
	1	2	3	4	5
1–7	4.61	4.58	4.62	4.69	4.55
8–14	15.74	15.62	15.77	15.77	15.75
15–21	21.38	21.92	21.85	21.41	20.98
22–28	30.05	29.85	30.05	30.63	29.73
29–35	35.37	36.13	36.53	35.86	25.19
1–35	21.43	21.62	21.76	21.67	19.24

(35 days), it should be noted that the highest rate was in quails of the 3rd experimental group – 0.33 g or 1.5% higher than control group. Quails of the 2nd and 4th experimental groups consumed a similar amount of feed, which is 0.19 g and 0.24 g (0.9 and 1.1%) more than the control group. Quails of the 5th experimental group consumed much less than control group, namely on 2.19 g or 10.2%.

During the whole period of the experiment, the quails of the 3rd experimental group consumed the most feed – 761.7 g/age/experiment, and the least – of the 5th experimental group – 673.4 g/age/experiment. Quails of the 2nd and 4th experimental groups consumed 756.7 and 758.5 g/age/experiment. The control quail group consumed 750.1 g/age/experiment.

An important economic and analytical indicator is the consumption of feed per 1 kg of body weight gain. Analyzing the results of calculating feed consumption per 1 kg of quails' body weight gain for giving feed mixtures with distillers dried grains with solubles (Tab. V), it was found that during the first week of life, the least feed for growth was spent by the 4th experimental quail group – 0.035 g or 2.4% less than control group. This indicator was also lower in the 3rd experimental quail group – by 0.023 g or 1.6%. In the 2nd and 5th experimental quail groups this indicator exceeded the control group by 0.054 g or 3.7% and 0.071 g or 4.9%.

During the third week of breeding, only the quails of the 5th experimental group exceeded the control birds in terms of feed consumption per 1 kg of BW gain – by 0.060 g or 2.3%. On the other hand, quails of the 2nd, 3rd and 4th experimental groups were inferior to control group by 0.107 g, 0.100 and 0.036 g respectively, which is 4.0%, 3.8 and 1.4% in percentage terms.

The feed consumption per 1 kg of body weight gain of the 3rd experimental group at the age of 22–28 days was equal to the control group. In the 2nd, 4th and 5th groups, the consumption of feed exceeded the control indicator by 0.038 g, 0.042 and 0.016 g or by 1.0% 1.1 and 0.4%.

In the last week of quail breeding, the lowest feed consumption was in the 3rd quail experimental group – by 0.274 g or 4.2% less than the 1st control quail group. During this period, the highest control indicator was only in the 5th experimental quail group – by 0.164 g or 2.5%. In the 2nd and 4th experimental quail groups, feed consumption per 1 kg of BW gain was lower by 0.141 g or 2.2% and 0.053 g or 0.8% than the control quail groups.

In general, for the entire 35-day-period of the experiment, the lowest feed consumption per 1 kg of weight gain was in the 3rd experimental quail group. According to this indicator, they were inferior to control group by 78 g or 2.4%. The 2nd and 4th experimental quail groups had the same indicators, which were inferior to the control group by 31 g or 0.9%. And only the 5th experimental quail group consumed 61 g or 1.8% more feed per 1 kg of growth than the control quail group.

During the experiment, livestock retention number was recorded on regular basis. To do this, the experimental poultry was inspected daily, dead individuals were removed. It should be noted that the retention number in all groups was at a high level of 97–98%.

The purpose of breeding the meat-type quails is the production of meat. Therefore, the analysis of slaughter quail rates is important (Tab. VI). The yield of slaughter products in percentage to the pre-slaughter weight was analyzed. Only the quails of the 3rd experimental group outweighed the control indicator of the pectoral muscles by 0.08%. Quails of the 2nd, 4th and 5th experimental groups were 0.08%, 0.63 and 0.28% inferior to the 3rd group. In terms of leg muscle output, experimental quail groups were inferior to control groups. This indicator in quails of the 2nd experimental group was lower than the control indicator by 0.64%, the 3rd experimental quail group – by 0.68%, the 4th experimental quail group – by 1.84% ($P < 0.01$), the 5th experimental group – 1.29% ($P < 0.05$).

The highest yield of internal fat was marked by quails of the 1st control group, as 2-; 3-; 4- and 5th experimental quail groups were inferior to this indicator by 0.03%; 0.19; 1.15 and 0.1%.

Liver yield of the 2nd and 3rd experimental quail groups was higher than control indicator by 0.22

V: *Feed costs per 1 kg of body weight (BW) gain, kg*

Age, days	Quail group				
	Control	Experimental			
	1	2	3	4	5
1–7	1.445	1.499	1.422	1.410	1.516
8–14	2.277	2.277	2.283	2.207	2.274
15–21	2.662	2.555	2.562	2.626	2.722
22–28	3.727	3.765	3.727	3.769	3.743
29–35	6.457	6.316	6.183	6.404	6.621
1–35	3.314	3.283	3.236	3.283	3.375

VI: *Output of slaughter products, %*

Index	Quail groups				
	Control	Experimental			
	1	2	3	4	5
Yield of half-gutted carcase	81.24 ± 0.290	81.36 ± 0.870	81.33 ± 0.530	79.83 ± 0.330*	80.17 ± 0.340
The output of the dressed carcase	76.34 ± 0.280	77.49 ± 0.340	76.41 ± 0.550	75.13 ± 0.240*	75.67 ± 0.480
Yield of edible parts:					
Pectoral muscles	16.16 ± 0.25	16.08 ± 0.340	16.24 ± 0.450	15.53 ± 0.160	15.88 ± 0.430
Leg muscles	11.93 ± 0.280	11.29 ± 0.210	11.25 ± 0.290	10.09 ± 0.240**	10.64 ± 0.220*
Skin	7.28 ± 0.260	7.57 ± 0.120	6.54 ± 0.210	7.33 ± 0.310	7.44 ± 0.260
Internal fat	1.44 ± 0.070	1.41 ± 0.050	1.25 ± 0.030	1.29 ± 0.080	1.34 ± 0.060
Liver	2.42 ± 0.250	2.64 ± 0.150	2.52 ± 0.210	2.08 ± 0.190	2.00 ± 0.070
Lungs	0.81 ± 0.070	0.99 ± 0.070	0.80 ± 0.060	0.77 ± 0.050	0.80 ± 0.040
Kidneys	0.70 ± 0.070	0.73 ± 0.040	0.54 ± 0.050	0.64 ± 0.040	0.62 ± 0.050
Muscular stomach	1.62 ± 0.210	1.72 ± 0.100	1.66 ± 0.090	1.67 ± 0.090	1.72 ± 0.040
Heart	0.95 ± 0.050	1.04 ± 0.050	0.91 ± 0.060	0.94 ± 0.040	0.91 ± 0.050

VII: *Meat indices*

Index	Quail groups				
	Control	Experimental			
	1	2	3	4	5
Carcase meatiness	52.4 ± 1.12	49.9 ± 0.72	50.7 ± 1.46	47.5 ± 0.57*	49.1 ± 0.86
Breast meat	21.2 ± 0.36	20.7 ± 0.36	21.3 ± 0.64	20.7 ± 0.25	21.0 ± 0.47
Leg meat	15.6 ± 0.43	14.6 ± 0.26	14.7 ± 0.42	13.4 ± 0.30*	14.1 ± 0.21*
Output of edible parts	72.4 ± 1.82	70.7 ± 0.79	69.3 ± 1.49	67.1 ± 0.58	68.7 ± 0.67
Bones	27.6 ± 1.82	29.3 ± 0.79	30.7 ± 1.49	32.9 ± 0.58	31.3 ± 0.67

and 0.10%, while in the 4th and 5th experimental quail groups – lower by 0.34 and 0.42%.

Lungs and hearts yield had a similar tendency. Control indicator was exceeded only in the 2nd experimental quail group – by 0.28 and 0.09%. Quails of the 3rd and 5th experimental groups had identical indicators of lung and heart yield, which were inferior to control indicator by 0.01 and 0.04% and also the 4th experimental group was inferior to control indicator by 0.04 and 0.01%.

The quails of the 2nd and 5th experimental groups had the same output of the muscular stomach, which was higher than the control indicator by 0.10%. Quails of the 3rd and 4th experimental groups were very similar in terms of gastric muscle yield and exceeded the control group by 0.04 and 0.05%.

Meat indices are an additional indicator of the poultry meat quality. The total yield of edible parts (Tab. VII) was the highest in quails of the 1st control group. Therefore animals 2-; 3-; 4- and 5th experimental groups were inferior to them in the yield of edible parts by 1.7; 3.1; 5.3 and 3.7 or 2.3%; 4.3; 7.3 and 5.1%.

According to the carcase meat index, the advantage of control group over quails in 2-; 3-; 4- and 5 experimental groups were 2.5; 1.7; 4.9 ($P < 0.05$) and 3.3, which in percentage terms is 4.8%; 3.2; 9.4 ($P < 0.05$) and 6.3%.

The index of breast meat was the same in birds of the 2nd and 4th experimental groups and lower than the control indicator by 0.5 or 2.4%. Quails of the 5th experimental group also lost to control group over this indicator – by 0.2 or 0.9%. And only the quails of the 3rd experimental group outperformed the control analogues in the breast meat index by 0.01 or 0.5%.

The 1st control quail group was dominated by the experimental groups of leg meat. So the 2-; 3-; 4- and 5th experimental quail groups were inferior to them in this index by 1.0; 0.9; 2.2 ($P < 0.05$) and 1.5 units ($P < 0.05$), which is 6.4%; 5.8; 14.1 ($P < 0.05$) and 9.6% ($P < 0.05$).

Thus, the assessment of slaughter quail qualities for giving feed mixtures of distillers dried grains with solubles showed that the highest rates were achieved by the 3rd experimental quail group.

DISCUSSION

In our studies, a positive effect of giving feed mixtures with a content of 5–15% of distillers dried grains with solubles to quails was noted. Similar conclusions were reached by other scientists. Thus, scientists (Konca *et al.*, 2011) claim that among the studied levels of distillers dried grains with solubles in quail feed, which is 10%, 20 and 30%, the highest productivity was achieved by those who consumed feed containing 20% of distillers dried grains with solubles.

El-Abd *et al.* (2017) publish scientific papers showing the positive effects of including both 30% and 60% of distillers dried grains with solubles in quail feed. In this case, the highest absolute increase more than 9.1% comparing to the control group is when distillers dried grains with solubles constitute 60% in the feed mixture. And with a share of 30% increase in absolute growth is 8.1%.

A number of scientists in their studies on broiler chicken have shown that the feeding of 4% and 6% PVMA (protein-mineral-vitamin supplement), which includes 45% of distillers dried grains with solubles as part of the feed, helps to increase the average daily gain by 0.5 and 1.2% (Ulitko *et al.*, 2010). The results of other studies, conducted in Russia (Egorov *et al.*, 2004), showed that the feeding of broiler chicken with addition of 4% and 6% of distillers dried grains with solubles from barley, helps to increase the average BW gain by 2.7 and 2.0%.

Thus, the results of our research are conformed on the experimental data of foreign scientists on the positive effect of distillers dried grains with solubles in the feed on the quail growth. However, it should be noted that in our studies, increasing the content of distillers dried grains with solubles to 20% had a negative impact on the productivity of quails relative to control indicator; and in the experiments of foreign researchers even at 30% and 60% of this feed in the diet of meat-type quails their daily BW gain exceeded the control group.

Increasing the growth quail rate can occur only with the accumulation of more nutrients in the tissues of their body. Therefore, quails should either consume more food or better digest its nutrients. In our research it was noted that quails of a meat type consumed more feed, namely: at the level of 5% of distillers dried grains with solubles in a feed mixture – by 0,9%, 10% – by 1.5%, 15% – by 1, 1% compared to the control group. Quails whose feed contained 20% of distillers dried grains with solubles consumed 10.2% less feed than control quail group. At the same time, per 1 kg of BW gain, quails consumed: including 5% and 15% of distillers dried grains with solubles in the diet – 0.9% less feed than control quail group, 10% of distillers dried grains with solubles – 2.4% less feed, and 20% distillers dried grains with solubles – 1.8% more feed.

In the studies El-Abd *et al.* (2017) it was noted that when the content of distillers dried grains with solubles constituted 30% of feed mixture, quails consumed 1.2% more feed, but its cost per kilogram of growth decreased by 6.4%. Increasing the share of distillers dried grains with solubles in feed to 60% helped increase the amount of feed consumed by 3.8% and reduce its costs by 4.9%. A similar tendency may be seen in studies conducted by scientists on broiler chickens (Ulitko *et al.*, 2010). Thus, birds, whose feed mixtures contained 4% and 6% PVMA (*protein-mineral-vitamin suplement*), adding 45% of distillers dried grains with solubles, consumed it more than control animals by 1.6%. Egorova T. noted that giving broiler chickens feed mixtures with a content of 4% and 6% of distillers dried grains with solubles from barley helps to reduce feed consumption per kilogram of growth by 2.9 and 3.4% (Egorov *et al.*, 2004).

Considerable attention was paid to slaughter qualities in the course of scientific and economic experiment. Konca *et al.* (2011) have paid a lot of attention to the slaughter qualities of quails and the quality of meat while the consumption of 10–30% of distillers dried grains with solubles used in feed mixtures. They noted a statistically significant decrease in the mass of the pancreas and cecum, an increase in the dry matter content of meat. The fat content of the meat varied and each difference with the control group was statistically significant. There was also a tendency of the proportion increase of ash and protein in meat.

El-Abd *et al.* (2017) reported a tendency of decrease in the relative mass of the liver and muscle stomach, as well as increase in the relative mass of the heart by 30% and 60% of distillers dried grains with solubles in feed mixture.

Experiments on broiler chicken conducted by a group of scientists (Ulitko *et al.*, 2010) showed a slight moisture increase in white meat and a decrease of this indicator in red meat, as well as a slight increase in protein and a decrease in the proportion of ash for feeding 4% and 6% of PVMA (*protein-mineral-vitamin supplement*), which contained 45% of distillers dried grains with solubles. Researchers (Schilling *et al.*, 2010) reported a slight increase in fat and a decrease in the proportion of moisture and protein in the pectoral muscles when feeding broiler chicken with 6%, 12%, 18% and 24% of distillers dried grains with solubles. Instead, the leg muscles of these chickens showed a slight decrease in fat, an increase in humidity and fluctuations in protein content, both upward and downward.

CONCLUSION

Our results provide evidence that giving young quails of meat type the complete feed mixture with a content of 10% distillers dried grains with solubles helps to increase the average daily gain of their BW by 3.0% ($P < 0.01$); as well as reduce feed costs per 1 kg of body weight gain per 2.4%. At the same time, the use of feed with a content of 15% bard helps to reduce the yield of dressed carcase and leg muscles and reduces the meat index of the carcase by 4.9% ($P < 0.05$) and the index of leg meat by 2.2% ($P < 0.05$).

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