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ORIGINAL ARTICLE

Effect of indoor light on quail meat productivity

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We investigated the effect of LED lamps and incandescent lamp bulbs on the productivity and slaughter quality of Pharaoh breed meat quaility. LED lamps had power output of 16 W, luminous flux of 1400 Lm, and color temperature of 4200 K. Incandescent lamp bulbs had power output of 40 W, luminous flux of 500 Lm, and color temperature of 2300-2900 K. From the 6th day of rearing the light, the intensity was 10-15 Lk within the level of live weight. We established a positive influence of LED lamps on quail slaughter qualities. The quails of experimental group (with LED lamps) had the advantages in terms of live weight (it was higher by 21.5 g or 8.23%, P> 0.999), the gains, feed conversion ratio (higher by 0.2 kg, or 5, 08%), quail liveability (higher by 4%). According to the results of the control slaughter, we admited a striking privilege in the level of slaughter weight and the eviscerated carcass of the poultry of the experimental group. The difference between groups is significant (P> 0.95…0.999). The advantages of the quails from experimental group towards the output of thigh muscles (higher by 0.02%), the drumstick muscles (0.12%), and the liver (by 1.02%) were obvious. The anatomical indices confirmed the influence of indoor lighting source on quali slaughter quality, i.e. the index of carcass food part and leg meat from experimental group were higher, the same was true with the indices of muscle and muscle breast of the quail of the control group with incandescent lamp bulbs.

Keywords: Quails; LED lamps; Rearing; Productivity; Slaughter features

Introduction

Among the various types of farm poultry, quails (Coturnix coturnix) are widely used in the agricultural sector for the production of valuable food - eggs and meat (Lukanov, 2019; Melnyk et al., 2019; Minvielle, 2004; Shanawany, 1994). In our country, the production of quail is concentrated at private farms, where the technological process is adjusted in accordance with current normative and regulatory documents. The productivity level of poultry of modern breeds and crosses is conditioned both by the genetic potential of productivity and by the influence of environmental factors (Melnyk et al., 2008; Cahaner, 1990). That`s why, the issue of genotype and environmental role in the formation and expression of features is relevant. This problem has been recently intensified as a result of the application of new technologies, feed and stimulants, automation and mechanization tools, etc in the production process (Chu et al., 2019; Kochish et al., 2010; Mohov, 1998).

Several various technological techniques are introduced, particularly using resource-saving lighting with variable physical characteristics to increase the economic efficiency of production. Different types of lamps - incandescent, fluorescent, and LED were used in premises for the poultry. Each type has its advantages and disadvantages. The most promising was the LED lamps, due to low power consumption, duration and ease of use. It is known that the physical characteristics of indoor lighting have a specific effect on bird physiological state, which determines its growth, development, productivity, and behavior (Melnyk, 2015; Lewis&Morris, 1998; Manser, 1996).

Positive influence of LED lamps has been established on the productivity of farm poultry, namely the growth and development and productivity of laying hens, broiler chickens rearing index, and productivity of egg quails (Nelson et al., 2020; Olanrewaju et al., 2018; Vakulenko, 2014; Sultana et al., 2013). In order to justify the use of LED lamps for the production of quails products, it was necessary to study its effect on the productivity and slaughter features of quails.

Material and Methods

The experimental studies were conducted in educational-scientific laboratory of poultry technologies of the National University of Life and Environmental Sciences of Ukraine. We used the method of groups-analogues and young meat quail of the Pharaoh breed. In daytime, 100 heads were selected, which formed 2 groups (control and experimental) towards the principle of analogues. Each group had 50 qualis. The incandescent lamp bulbs were a source of light in the control group while in the experimental group we used the LED lamps. The experiment lasted for 49 days. The temperature, humidity and lighting of the poultry premises corresponded to the regulations and sanitary standards adopted for quails. The landing density of quails was 73 cm^2 per head, feeding front - 1.5 cm. The water consumption in the quails was done by using standard 1.5 L vacuum water for 25 quails. The birds consumed feed and water without restrictions. Full-feed bulk feedstuffs, which correspond nutritionally to the standard, were used to feed the quails. Incandescent lamp bulbs of 40 W with luminous flux of 500 lm and a color temperature of 2300-2900 K were used to lighting the room of the control group of quails. "Horoz Led Globe" LED lamps of 16 W with luminous flux 1400 lm and a color temperature of 4200 K were used to light the quails in the experimental group. The light intensity was 10-15 Lk from the 6th day of quail rearing. In order to study the growth dynamics, the all quails were individually weighted at weekly intervals. Based on live-weight indices obtained: the absolute live weight gain, average daily weight gain and relative weight gain by the common formulae. Feed-stuff consumption was determined based on the group records. The number of dead birds was recorded daily. The

estimation of the meat quality of quail was carried out by means of control slaughter and anatomical dissection of carcasses (Guidelines, 2004). During the slaughter of quails its qualities were determined (slaughter weight, semi-eviscerated carcass, eviscerated carcass). Identification of anatomic and morphological indicators was performed when evaluating 3 males from each group including anatomical dissection of carcasses and weighing of parts and organs. The yield of carcasses and organs was determined as a percentage to pre-slaughtered live weight. We used MS Escel software for the data processing. The data in the tables were presented as means and standard deviations.

Results and Discussion

The results of quails rearing indicate a significant impact of the investigated paratype factor (Table 1). The highest level of body weight of the bird of the experimental group was established from the 7th day of life until the end of rearing. The difference between the groups is 1.0-21.5 g, or 3.60 ... 8.23%. From 28 days of bird rearing, a difference between the groups becomes significant (P> 0.999). This confirms the positive influence of the studied factor on the level of body weight.

Table 1. Results of quails rearing (n=50).

Age, day	Body weight, g		Feed intake per bird per day, g		Livability, %	
	Control group	Experimental group	Control group	Experimental group	Control group	Experimental group
1	10.0 ± 0.29	10.0 ± 0.22	-	-	100	100
7	27.8 ± 0.89	28.8 ± 0.55	6.10	5.30	96	96
14	66.7 ± 1.48	69.5 ± 1.51	11.30	12.80	92	92
21	114.8 ± 2.12	122.5 ± 2.67	21.60	22.01	92	90
28	127.1 ± 0.82	141.9 ± 2.23***	22.80	23.30	90	90
35	178.7 ± 2.98	189.7 ± 3.63*	24.90	25.88	88	90
42	224.8 ± 3.04	243.4 ± 4.23***	26.80	27.43	88	90
49	261.4 ± 3.61	282.9 ± 4.98***	29.30	30.31	86	90

Here and then *p ≤ 0.05, ***p ≤ 0.001 compared to control

The feed intake of quails in the experimental group for the whole rearing period is higher - 1029 g compared to 999.6 g in the control group. But in terms of feed conversion ratio, the best results were obtained in the experimental group - 3.74 kg versus 3.94 kg, the difference being 0.2 kg or 5.08%. Considering that, in the overall structure of the cost of poultry meat production, feed below-costs are 60-70%, that makes a significant difference between the groups. The quail liveability of the experimental group was higher in 4%, which is a significant index. The quails of experimental group were superior due to an absolute weight gain dynamics (Table 2). The difference by absolute live weight gain between the experimental and control groups was 20.6 g or 8.19%, by average daily weight gain – 0.44 g or 8,56%, relative weight gain -1.08% or 0.58%.

Table 2. Weight gains dynamic of quails (n=50).

Age periods, days	Absolute live weight gain, g		Average daily weight gain, g		Relative weight gain, %	
	Control group	Experimental group	Control group	Experimental group	Control group	Experimental group
0-7	17.83	18,80	2.54	2.69	94.18	96.91
8-14	38.87	40.70	5.56	5.81	82.33	82.81
15-21	48.11	53.00	6.87	7.57	53.02	55.21
22-28	12.35	19.40	1.76	2.78	10.17	14.67
29-35	51.52	47.80	7.37	6.82	33.75	28.83
36-42	46.12	53.70	6.59	7.67	22.85	24.80
43-49	36.63	39.50	5.23	5.65	15.06	15.01
0-49	251.40	272.90	5.13	5.57	185.26	186.34

The most objective indices that characterize the meat qualities of poultry are the slaughter weight and the yield of eviscerated carcass. They are capable of estimating the amount of final product obtained from poultry processing. According to the results of the control slaughter, we admit a benefit according to the level of these indicators of the experimental group poultry (Table 3), the difference between groups is significant (P> 0.95, P>0.999). The yield of the semi-eviscerated carcass in the quails of the control group is higher in 1.14%. But it worth mentioning that this indicator is not the main one while evaluating the slaughtering qualities.

The advantages of the quails of the experimental group by mass of parts of the carcass was calculated according to mass of parts of the carcass. In terms of liver mass, this difference (0.12%) is significant (P> 0.95). Evaluation of the yield of parts of the carcass indicates a higher output of the breast muscles (by 0.5%), wing muscles (by 0.06%), gizzard (by 0.03%), heart (by 0.11%) within poultry of the control group. Quails of the experimental group gave the output of the thigh muscles which is higher (by 0.02%), the drumstick muscles (0.12%). There was no difference (P <0.05) between the groups based on these indicators.

The calculation of anatomical indices (Table 4) confirms the revealed peculiarities of the influence of the paratype factor on the slaughter quality of the quail - the index of muscle and muscle breast is higher for the quail of the control group, but the index of the food part of carcass and the leg meat is higher for the experimental group poultry.

Table 3. Slaughtering qualities of quails (n=3).

Indicators	Control group		Experimental group	
	g	%	g	%
Pre-slaughter live weight (Body weight before slaughter)	245.9±3.45	-	264.3±4.02*	-
Slaughter weight	224.2±2.99	91.18	242.1±4.12*	91.60
Semi-eviscerated carcass	177.8±2.64	72.31	189.6±3.64*	71.17
Eviscerated carcass	151.4±1.02	61.57	163.6±1.19***	61.90
Breast muscles	52.41± 0.71	21.31	55.10 ± 2.54	20.81
Thigh muscles	21.53 ± 0.99	8.76	23.20 ± 1.36	8.78
Drumstick muscles	15.57 ± 0.53	6.33	17.06 ± 0.77	6.45
Wing muscles	13.40 ± 0.53	5.45	14.25 ± 1.05	5.39
Gizzard stomach	5.26 ± 0.52	2.17	5.66 ± 0.41	2.14
Liver	5.67 ± 0.56	2.31	8.79 ± 0.98*	3.33
Heart	2.22 ± 0.19	0.90	2.10 ± 0.12	0.79

Table 4. Anatomical indexes.

Muscle	67.97	67.00
Food Part Of Carcass	76.66	77.11
Muscle Leg	24.50	24.61
Muscle Breast	34.62	33.68

The cost-effectiveness calculations of rearing quails (Table 5) indicate a significant economic effect of using LED lamps. It is caused by both energy savings (UAH 9.74 per 1 head) and additional production output (UAH 2.83 per 1 head).

Table 5. Cost effectiveness of quail meat production.

Electricity consumption during the quails rearing period, kW/h	8.330	5.355
Cost of electricity consumed, UAH	1364.45	877.15
Sales Revenue, UAH	1067.82	1209.40
Additional income from electricity savings, UAH/%	–	487.3 / 35.71
Additional income from the sale of meat, UAH/%	–	141.58/ 13.26
The economic effect of the use of LED lamps, UAH	-	628.88

Conclusion

The use of LED lamps as a light source for rearing meat quail of Pharaoh breed has a positive impact on productivity and slaughter quality of poultry. The results of rearing quails indicate a significant impact of the investigated paratype factor. The quails of experimental group had the advantages considering the level of body weight (by 21.5 g or 8.23%, P>0.999), by its gains, feed conversion ratio (by 0.2 kg, or 5.08 %), quail liveability (by 4%). According to the results of the control slaughter, we admit the advatage for the level of slaughter weight and the eviscerated carcass of the experimental group poultry. The difference between groups is rather significant (P> 0.95…0.999). The advantages of the quails of the experimental group based on the output of the thigh muscles (by 0.02%), the drumstick muscles (0.12%), and the liver (by 1.02%). The calculation of anatomical indices confirms the revealed peculiarities of the influence of the paratype factor on the slaughter quality of the quail. The index of the food part of carcass and the leg meat of the quail of the experimental group is higher. The cost-effectiveness calculations of rearing quails confirm that the use of LED lamps is an effective resource-saving technique in the process of quail meat production.

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