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INFLUENCE OF DIETS WITH DIFFERENT LEVELS OF CRUDE PROTEIN ON PRODUCTIVITY, SLAUGHTERING CHARACTERISTICS AND CHEMICAL COMPOSITION OF MEAT OF COMBINED PRODUCTIVITY LINE OF UKRAINIAN SELECTION

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The study was conducted at the experimental farm "Preservation of the State Poultry Gene Pool" of the Department of Animal Husbandry and Veterinary Sciences of the NAAS using male chickens of the meat-egg population "Hercules White" of the combined type of productivity. The effect of diets with different levels of crude protein on production indicators, slaughter characteristics and chemical composition was determined. meat of male chickens of the combined direction of productivity of Ukrainian selection. 180 day-old male chickens were divided into 3 groups, which were subsequently grown under similar technological parameters in separate isolated sections and fed with diets with different levels of crude protein in the starting, growth and finishing periods: 1st group - 23%, 21% and 19%; 2nd group - 21.5%, 19% and 17%; 3rd group - 20%, 17% and 15%. The content of metabolizable energy 300 kcal/100 g, 310 kcal/100 g, 320 kcal/100 g and other nutrients in the diets of cockerels of the same age was the same. According to the results of growing The advantage of male birds of the 1st experimental group in terms of live weight compared to other groups persisted until 10 weeks of age. At 8 weeks of age, it was statistically significant (P <0.05) only between chickens of groups 1 and 2. At 12 and 14 weeks of age, the cockerels of group 3 had the largest live weight, although the difference was insignificant and statistically insignificant. According to the data of slaughter at the age of 14 weeks 90.39% - 89.98%. The slaughter yield of semi-gutted carcasses was higher than that at the fattening period of 8 weeks, by 3.96-3.74%. Analysis of the chemical composition of the meat of male birds of the experimental groups showed that with age the moisture content of the pectoral muscles in the 3rd group decreased compared to the first, it was lower by 0.4% at 14 weeks, but the crude protein content increased by 1.1% compared to 8 weeks. The crude lipid content in the thigh muscles was higher than in the pectoral muscles by 1.9-2.0 times. The pH of the thigh muscles was higher than the pH of the pectoral muscles by 3.7-6.0%. No significant differences were found for any sensory parameter. The feed conversion ratio during the entire period of cockerel rearing was numerically better in group 1 and the worst in group 3. However, if after 8 weeks of rearing the difference in this indicator

between these groups was 9.9%, then it decreased and at 14 weeks of age was only 3.5%. Feed consumption per 1 kg of live weight gain in the second group was higher compared to group 1 by 2.3%, in group 3 it was higher compared to group 1 by 3.5%, and compared to group 2 by 1.1%. At the same time, the cost of feed consumed per 1 kg of live weight gain in the 2nd group was lower compared to the first group by 9.86%, in the 3rd group it was lower compared to the 1st group by 22.18% and by 13.64% compared to the 2nd group, which indicates the economic feasibility of fattening cockerels on low-protein diets.

Keywords: poultry, feeding, crude protein, feed conversion, slaughter performance, chemical composition of meat.

ВПЛИВ РАЦІОНІВ З РІЗНИМИ РІВНЯМИ СИРОГО ПРОТЕЇНУ НА ПРОДУКТИВНІСТЬ, ЗАБІЙНІ ХАРАКТЕРИСТИКИ ТА ХІМІЧНИЙ СКЛАД М'ЯСА ПІВНИКІВ КОМБІНОВАНОГО НАПРЯМУ ПРОДУКТИВНОСТІ УКРАЇНСЬКОЇ СЕЛЕКЦІЇ

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Дослідження проведено на експериментальній фермі «Збереження державного генофонду птиці» ДДСП ІТ НААН з використанням півників м'ясо-яєчної популяції «Геркулес білий» комбінованого типу продуктивності. Визначали вплив раціонів з різним рівнем сирого протеїну на виробничі показники, забійні характеристики та хімічний склад м'яса півників комбінованого напряму продуктивності української селекції. 180 добових півників було розділено на 3 групи, які в подальшому вирощували за аналогічних технологічних параметрів в окремих ізольованих секціях та годували раціонами з різним рівнем сирого протеїну в стартовий, ростовий і фінішний періоди: 1-а група - 23%, 21% і 19%; 2-а група - 21,5%, 19% і 17%; 3-я група - 20%, 17% і 15%. Вміст обмінної енергії 300 ккал/100 г, 310 ккал/100 г, 320 ккал/100 г та інших поживних речовин в раціонах півників одного і того ж віку був однаковим. За результатами вирощування перевага півників 1-ї дослідної групи за живою масою порівняно з іншими групами зберігалася до 10-тижневого віку. У 8-тижневому віці була статистично вірогідною (P<0,05) тільки між курчатами 1-ї і 2-ї груп. В 12-и та 14-тижневому віці найбільшу живу масу мали вже півники 3-ї групи, хоча різниця і була незначною та статистично невірогідною. За даними забою у віці 14 тижнів 90,39% – 89,98%. забійний вихід напівпатраних тушок був більший, ніж за терміну відгодівлі 8 тижнів, на 3,96-3,74%. Аналіз хімічного складу м'яса півників дослідних груп показав, що з віком знижувалася вологість грудних м'язів у 3-й групі порівняно з першою була меншою на 0,4% в 14 тижнів але збільшувався вміст сирого протеїну на 1,1% порівняно з 8-ми тижнями. Вміст сирих ліпідів в м'язах стегна був

більший, ніж в грудних м'язах в 1,9-2,0 раза. pH м'язів стегна був більший ніж pH грудних м'язів на 3,7-6,0%. За жодним сенсорним показником не було встановлено істотних відмінностей. Коефіцієнт конверсії корму протягом всього періоду вирощування півників чисельно був кращий у 1-й групі і найгірший у 3-й групі. Однак, якщо за 8 тижнів вирощування різниця за цим показником між цими групами складала 9,9 %, то далі вона зменшилася і в 14-тижневому віці становила тільки 3,5 %. Витрати корму в розрахунку на 1 кг приросту живої маси у другій групі були вищими порівняно з 1-ю групою на 2,3%, у 3-й групі вищі порівняно з першою групою на 3,5%, а порівняно з 2-ю групою на 1,1%. В той же час вартість витрачених кормів в розрахунку на 1 кг приросту живої маси при в 2-й групі була меншою порівняно з першою групою на 9,86%, в 3-й групі меншою порівняно з 1-ю групою на 22,18% і на 13,64% порівняно з 2-ю групою, що свідчить про економічну доцільність відгодівлі півників на низькопротеїнових раціонах.

Ключові слова: птиця, годівля, сирий протеїн, конверсія корму, забійні показники, хімічний склад м'яса.

Introduction. Over the past 30 years, the world has seen rapid growth in chicken production. Only in the period from 2000 to 2022, it increased by more than 2.0 times, exceeding 111 million tons in 2022. Of this amount, about 89.5% was meat from broiler chickens grown using intensive technologies (Melnyk et al., 2023).

But recently, intensive technologies for the production of broiler chicken meat in countries with developed poultry farming have been increasingly criticized: firstly, because the use of intensive crosses allegedly forces the bird's body to function at the limit of its physiological capabilities, which negatively affects its health; secondly, because the growing conditions do not allow the bird to realize its natural behavioral characteristics and are inhumane; and thirdly, because the resulting meat is allegedly tasteless and has low nutritional value (El Jeni and al., 2021).

As an alternative to intensive chicken production technologies and the use of intensive crosses, a transition to rearing systems that improve the welfare of the bird, such as free-range or organic, is proposed. In this case, mainly genotypes of so-called "slow" growing broiler chickens or cockerels of combined productivity (meat and egg) are used (Sandilands, 2012; Bosco, 2014).

A more promising direction for the development of egg poultry farming in the EU is considered to be the use of chickens with dual (combined) productivity (König et al., 2012). Hens are used for eggs, cocks for fattening for meat, while maintaining acceptable productivity and economic benefit (Icken, 2013; Baldinger and al., 2021; Leiber and al , 2025; Petkov, 2022).

Dual-purpose chickens lag behind specialized layers and broiler crosses in terms of egg and meat production, and they consume more natural resources. Nevertheless, poultry systems that are economically viable, environmentally sound, and socially acceptable could serve certain market segments (Bruijnis and al., 2015; Damme et. al., 2015).

In the case of dual-purpose production, chickens are usually raised free-range, and the price of eggs and meat can reach a premium - due to the positive perception by consumers of the method of keeping birds for health, the environment and the taste of the product (Hemmerling, 2012).

Thus, breed selection is an important factor for small and medium-sized producers, who take into account the ability of animals to adapt to local conditions, their viability and tolerance to diseases (Jaturasitha, 2008). The solution in this direction remains relevant to this day. At the same time, the potential of dual-purpose genotypes

adapted to free-range farming should be determined through systematic performance tests that help producers make decisions about farm management.

A number of studies have been conducted to study the fattening qualities and nutritional value of meat from combined-type male chickens, the impact of different rearing systems and feeding rations on their performance. It has been found that in order to achieve a live weight comparable to intensive broiler crosses, combined-type male chickens require approximately twice as much time and significantly more feed per kg of gain (Icken, 2013, Murtini, 2020).

Since feed is the most important factor in the total cost of poultry production, when determining the most cost-effective feeding rates, it is necessary to assess the birds' nutrient needs, especially protein, which constitutes the bulk of these costs and has a large impact on performance (Suprijatna, 2020; Ding et al. et al., 2016; Beski, 2015. Afrin et. al., 2024).

In Ukraine, raising male chickens for meat of a combined productivity direction may be a niche that could be occupied by poultry farms, since large poultry enterprises will have little competition with them here.

In recent years, several promising subpopulations of chickens of combined productivity have been created on the basis of the State Research Station of Poultry Breeding of the NAAS, which are united under the general name "Birkiv Meat-Egg" and registered under the trademark "Hercules". Poultry of this selection is characterized by high productivity indicators: the live weight of adult chickens is 2.9–3.3 kg, roosters - 4.0–4.5 kg (in some cases up to 7 kg), and egg production reaches 220 eggs per year.

Given the significant potential for live weight gain, raising cockerels of this group for meat is a promising direction for poultry farming (Melnyk et al., 2023). However, their feeding standards in farm conditions, as well as technological parameters of cultivation, have not yet received proper scientific justification. Existing data on optimizing diets are contradictory or obtained on other poultry lines, which complicates their practical application. This necessitates the search for optimal levels of nutrients to improve production indicators, product quality and increase the economic efficiency of production. In addition, special attention needs to be paid to studying the nutritional value of Hercules cockerel meat as a dietary product.

The aim of the research was to determine the effect of diets with different levels of crude protein on production indicators, slaughter characteristics and chemical composition of meat of male chickens of the combined productivity direction of Ukrainian breeding.

Materials and research methods. The research was conducted at the experimental farm "Preservation of the State Poultry Gene Pool" of the Department of Animal Husbandry and Veterinary Medicine of the National Academy of Sciences of the Ukrainian Academy of Sciences, using as the object of research 180 day-old male chickens of the meat-egg population Hercules white of the combined type of productivity, which were divided into 3 groups of 60 birds in each group. Each group was placed in a separate section on the litter with similar parameters of planting density (8 birds/m ^{2}), feeding front (12 cm/bird) and watering (5 cm/bird). The lighting regime was applied: up to 4 weeks of age - 23 hours of daylight with illumination within 40-20 lux; subsequently - 16 hours of daylight with illumination 5-10 lux. The temperature regime and air exchange parameters in the poultry house met the requirements of current regulatory documents of Ukraine (VNTP-APK-04.05). The period of raising cockerels was 14 weeks.

A 3-phase feeding of male birds with diets with different crude protein content was used in the starting (1-4 weeks), growing (5-10 weeks) and finishing (11-14 weeks)

periods. The content of metabolizable energy and other nutrients in the diets of male birds of the same age was similar (Table 1).

Table 1

Norms of metabolizable energy and nutrients in the diets of male birds of the experimental groups

Nutrient	Start-up period (1-4 weeks)			Growth ration (5-10 weeks)			Finishing period (11-14 weeks)		
	1 group	2 group	3 group	1 group	2 group	3 group	1 group	2 group	3 group
Crude protein, %	23.0	21.5	20.0	21.0	19.0	17.0	19	17	15
OE, kcal	300	300	300	310	310	310	320	320	320
Crude fiber (no more), %	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Ca, %	1.0	1.0	1.0	1.2	1.2	1.2	1.2	1.2	1.2
Phosphorus, %	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Sodium, %	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Feeding rations of male birds in the experimental groups are presented in Table 2.

Table 2

Feeding rations of male birds in experimental groups

Components	1-4 weeks			5 weeks and older		
	1 group	2 group	3 group	1 group	2 group	3 group
Corn	37,675	42,245	46,245	35,745	41,645	47,705
Wheat	10,000	10,000	10,000	18,000	18.00	18.00
Yeast	3,000	3,000	3,000	-	-	-
Soybean meal	25.00	20,000	16,000	39,000	32,800	26,500
Sunflower cake	10,000	10,000	10,000	-	-	-
Fish supplement	40,000	10,000	10,000	-	-	-
Sunflower oil	2,000	2,000	2,000	3,500	3,500	3,500
Bone meal	0.650	1,000	1,000	1,900	2,200	2,200
Limestone flour	1,400	1,400	1,400	1,300	1,200	1,300
Vitamin mixture	0.025	0.025	0.025	0.025	0.025	0.025
Mixture of trace elements	0.050	0.050	0.050	0.050	0.050	0.050
Lysine	0.200	0.200	0.200	0.150	0.200	0.300
Methionine	-	0.080	0.080	0.230	0.280	0.320
Salt	-	-	-	0.100	0.100	0.100
100 g of compound feed contains						
Metabolic energy, kcal	310	310	310	320	320	320
Crude protein, %	23.0	21.5	20.0	21.0	19.0	17.0
Fiber, %	4.0	4.0	4.0	4.0	4.0	4.0
Ca, %	1.0	1.1	1.0	1.2	1.2	1.2
P, %	0.7	0.7	0.7	0.7	0.7	0.7
Lysine, %	1.30	1.30	1.30	1.10	1.10	1.10
Methionine+cystine, %	0.65	0.65	0.65	0.75	0.75	0.75

Starting from 8 weeks of age, chickens of all groups were released for free range (1 m^{2} / head). In adverse weather, chickens were given chopped green feed - ad libitum.

During the growing period, the following indicators were determined:

- dynamics of live weight – by weighing all male birds of the experimental groups once a week at the same time on electronic scales with an accuracy of ±1.0 g;
- livestock safety – based on daily records;
- feed consumption - based on daily accounting;
- feed conversion – by calculation.

The European Production Factor Efficiency Index (EPEF) was determined using the following formula:

$$EPEF = \frac{live\ weight,\ \ kg\ \times\ livestock\ safety,\ \ \%}{growing\ period,\ \ days\ \times\ feed\ conversion,\ \ kg/kg} \times 100$$

The study of the slaughter characteristics of cockerels depending on the feeding rations was carried out by slaughtering, evisceration and dividing the carcasses into parts (not less than 3 cockerels from each experimental group at the age of 14 weeks). The mass and yield of semi-eviscerated and eviscerated carcasses, the mass of internal organs (heart, liver, gizzard, spleen), the mass and yield of various parts of the carcass (neck with head, pectoral muscles with and without skin, wings, thighs, internal and abdominal fat, skin, skeleton, paws) were determined as a percentage of the live weight of the bird and the mass of the eviscerated carcass. The division of the carcasses into parts was carried out in accordance with the requirements of the current regulatory documents of Ukraine: DSTU 3143:2013 Poultry meat. General technical conditions and DSTU UNECE ECE/ TRADE /355:2007. Chicken meat. Carcasses and their parts. Guidelines for supply and quality control. The yield of various parts of the carcasses was determined by weighing the obtained parts on an electronic scale with an accuracy of ±1.0 g. The mass of internal organs (heart, liver, gizzard, spleen) was determined by weighing on an electronic scale with an accuracy of ±0.1 g.

Determination of the chemical composition of cockerel meat depending on the feeding rations was carried out in the certified laboratory of the Department of Quality and Safety Assessment of Feeds and Poultry Products of the Department of Poultry Science and Technology of the National Academy of Sciences of the Republic of Ukraine. The content of moisture, crude protein, crude lipids and ash was determined in the pectoral muscles and thighs. Mixed (from 3 cockerels) samples of the specified parts of the carcass were analyzed.

Sensory analysis of the samples was carried out according to the method described by Fernandes yes Silva et al. (2017). For sensory analysis, samples of pectoral muscles and thigh muscles without bones, skin and external fat were taken from carcasses of cockerels cooled to 4 ° C (5 carcasses from each group). Samples from 0.25 % salt was subjected to heat treatment at a temperature of 180 °C for 30 minutes. After preparation, the samples were cut into relatively uniform pieces and submitted for testing. Testing was carried out by 10 randomly selected experts. Each expert was presented with 4 samples for testing: one named K (control) and three coded ones, one of which corresponded to the control. Sensory characteristics (color, smell, taste, consistency, juiciness and overall impression) on the rating scale: 1- extremely better than the control; 2- much better than the control; 3- usually better than the control; 4- slightly better than the control; 5- no differences from the control; 6- slightly worse than the control; 7- usually worse than the control, 8- much worse than the control, 9 - extremely worse than the control.

Statistical processing of research results was performed using application software for Windows OS – Microsoft Excel.

Research results. The productive indicators of cockerels fed with diets with

different levels of crude protein are shown in Table 3. As the results obtained showed, in the starting period (1-4 weeks) the largest live weight was in chickens of the 1st group, which were fed a diet with the highest crude protein content among other groups - 23%. However, the difference in live weight compared to cockerels of other groups was not statistically significant. Feed consumption per 1 kg of live weight gain during this period was also the lowest in the 1st group: 4.2% less than in the 2nd group and 8.4% less than in the 3rd group.

Table 3

Main performance indicators of cockerels

Indicators	Group		
	1	2	3
Planted for raising day-old chicks, head.	60	60	60
Live weight of chickens (g) at age, weeks			
4	374.76±9.799	361.66±11	349.61±10.3
8	1295.0035.60[a]	1215.82±23.97[b]	1183.57±25.87[c]
10	1964.39±45.6	1864.97±27.25	1849.17±36.55
12	2482.74±48.43	2464.17±51.91	2497.444±0.78
14	3078.87±58.15	3011.17±65.42	3093.21±49.86
Feed consumption (kg/head) per period, weeks			
4	0.686	0.690	0.695
8	3.2	3.4	3.5
10	5.7	5.8	6.0
12	7.8	7.9	8.1
14	10.1	10.4	10.8
Cost of feed consumed per 1 head, UAH.	168.45	143.47	131.69
Cost of feed consumed per kg of live weight gain, UAH.	55.46	49.99	43.16
Feed conversion ratio (kg/kg) by increasing total for the period, weeks			
4	2.07	2.16	2.26
8	2.55	2.90	3.06
10	2.94	3.15	3.24
12	3.20	3.26	3.29
14	3.42	3.50	3.54
Survival (%) over the period, weeks			
4	96.6	98.3	98.3
8	95.0	96.6	96.6
10	95.0	95.0	95.0
12	95.0	93.3	95.0
14	93.3	93.3	95.0
EPEF			
4	63	59	54
8	86	72	67
10	90	80	77
12	88	84	86
14	86	82	85

Note: The difference between indicators with different indices is statistically significant ($p \leq 0.05$).

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The advantage of male birds of the 1st experimental group in terms of live weight compared to other groups persisted until 10 weeks of age. But only at 8 weeks of age the difference compared to other groups was statistically significant. However, at 12 and 14 weeks of age, the greatest live weight, although the difference was insignificant and statistically insignificant, was already possessed by male birds of the 3rd group, which were fed a diet with the lowest level of crude protein (15% in the finishing period).

At the age of 8 and 10 weeks, the largest live weight was in chickens of group 1, which were fed a diet with the highest level of crude protein: up to 4 weeks of age 23%, over 4 weeks of age – 21% (see Fig. 1). However, the difference in live weight was statistically significant ($P < 0.05$) only between chickens of groups 1 and 2. At the age of 12 and 14 weeks, chickens of group 1, which were fed a mixed feed with the lowest level of crude protein compared to other groups, had a slightly higher live weight compared to other groups (20% up to 4 weeks of age and 17% thereafter), but the difference between groups was statistically insignificant.

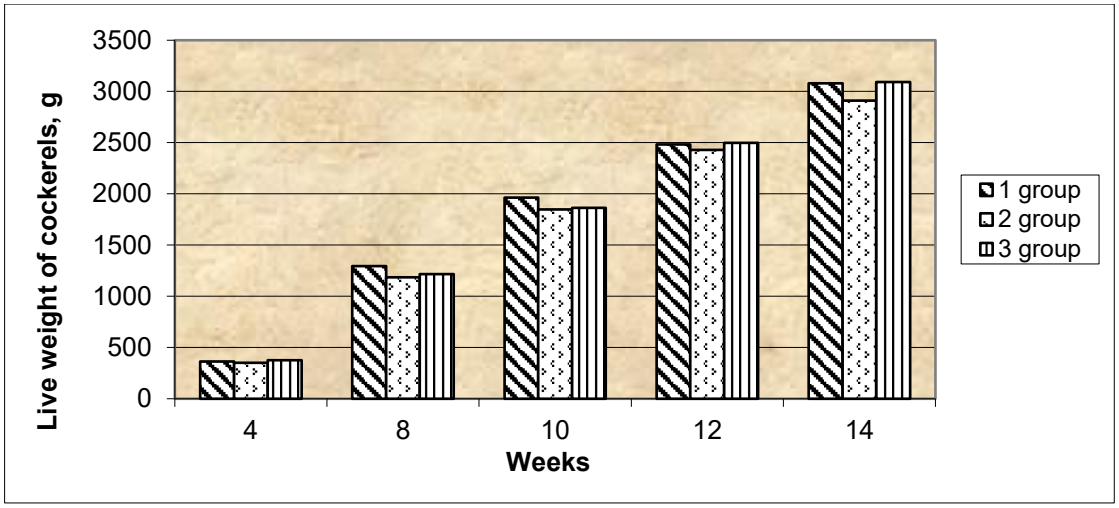

Fig. 1. **Dynamics of live weight of male chickens during the fattening period**

The feed conversion ratio during the entire period of cockerel rearing was numerically better in group 1 and worst in group 3 (see Fig. 2). However, if after 8 weeks of rearing the difference in this indicator between these groups was 9.9%, then it decreased and at 14 weeks of age was only 3.5%.

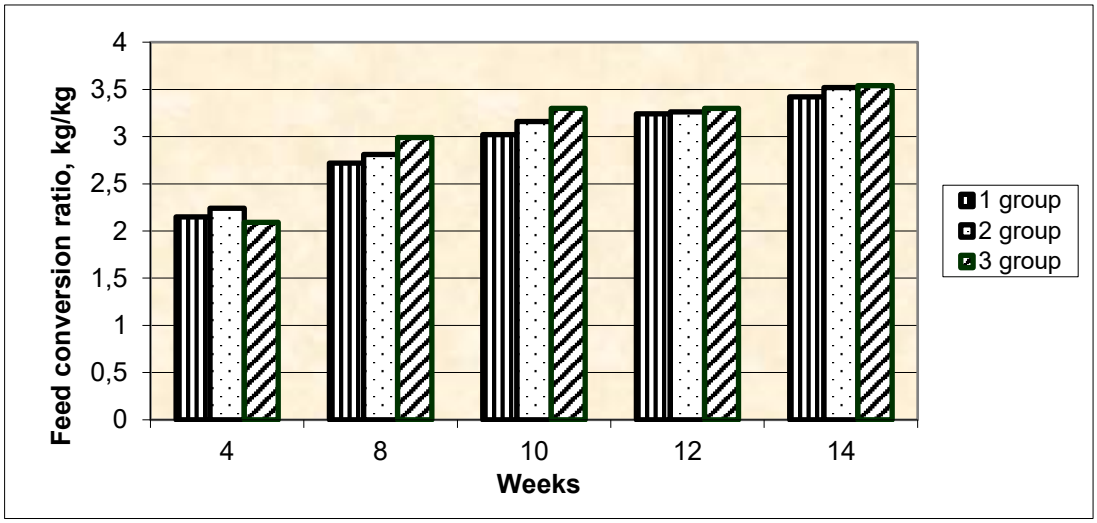

Fig. 2. **Feed conversion ratio**

Feed conversion throughout the growing period was best in group 1, which was fed diets with the highest crude protein level, and worst in group 3, which was fed diets with the lowest crude protein level. Over a total growing period of 14 weeks, feed consumption per kg of live weight gain in group 2 was higher compared to group 1 by 2.3%, in group 3 higher compared to group 1 by 3.5%, and compared to group 2 by 1.1%. At the same time, feeds with a lower protein level were cheaper and their use ensured a reduction in the cost of fattening. Thus, the cost of feed in the 1st group was 55.45 UAH/kg of live weight gain, in the 2nd group – 49.99 UAH/kg of live weight gain, in the 3rd group – 43.16 UAH/kg of live weight, or in the 2nd group it was lower compared to the first group by 9.86%, in the 3rd group it was lower compared to the 1st group by 22.18% and by 13.64% compared to the 2nd group. This indicates the economic feasibility of fattening cockerels on low-protein diets.

No significant difference was found between the groups in terms of bird survival. In the 1st and 2nd groups, the survival of male birds for 14 weeks of rearing was 93.3%, in the 3rd group 95%. The death of male birds during the rearing period was: in the 1st and 2nd groups - 4 heads each, in the 3rd group - 3 heads. The death of the bird was not associated with its feeding.

The European Production Factor Efficiency Index (EPEF) during the period of growing male birds up to 10 weeks of age was significantly higher in group 1. However, at the final stage of fattening, the difference in this indicator between the groups significantly decreased.

The slaughter characteristics of cocks are given in Table 4, the weight of internal organs in Table 5. According to the data on slaughter and separation of slaughtered poultry, a tendency was noted to increase the yield of gutted and semi-gutted carcasses with an increase in the fattening period of cocks. So, if at the age of 14 weeks 90.39% - 89.98%. the slaughter yield of semi-gutted carcasses was higher than at the age of 8 weeks, by 3.96-3.74%. To a lesser extent, the difference in slaughter yield depending on the content of crude protein in the feed was expressed, although some advantage in this indicator was in cocks that were fed diets with a higher content of crude protein . So, after 14 weeks of fattening, the difference in slaughter yield in cocks of the 1st and 3rd groups was 0.37%. The same trends were observed in the yield of eviscerated carcasses and pectoral muscles, which increased with increasing the period of fattening of male birds and the protein content in the diets.

No statistically significant differences were found between male birds of different groups in terms of internal organ mass depending on the protein content in the diets, although there was some numerical advantage in terms of internal organ mass in male birds of greater mass.

Table 4

Slaughter characteristics of roosters

Indicators	**Group**					
	1st		**2nd**		**3rd**	
	g	**% of the total**	**g**	**% of the total**	**g**	**% of the total**
Age 14 weeks						
Average live weight (LW), g	3573.33± 129.15	100	3608.33± 144.15	100	3656.67± 45.60	100

Average weight, g:						
half-gutted carcass	3229.93± 125.10	90.39	3426,67± 138.40	89.98	3291.67± 63.28	90.02
gutted carcass	2250.0± 118.60	62.97	2385.00 ± 79.69	62.63	2268.23± 29.65	62.03
neck with head	291.58± 8.90	8.16	295.16± 26.06	8.18	297.65± 30.48	8.14
Neck without a head	181.17± 8.90	5.07	184.75± 9.35	5.12	188.33± 30.48	5.15
pectoral muscles with skin	545.00± 18.37	15.25	564.33 ± 4.34	15.64	553.25± 10.80	15.13
pectoral muscles without skin	491.67± 19.47	13.76	515.00 ± 32.404	13.52	446.67± 14.289	12.22
thighs	811.67± 30.89	22.71	895.33± 33.7	19.12	838.33± 31.68	22.93
Hips	421.67± 14.29	11.80	435.00 ± 18.71	11.42	431.67± 7.36	11.80
Shin	390.00± 18.37	10.91	458.33± 35.41	12.00	406.673± 5.77	11.12
Wings	286.67± 14.29	8.02	298.332± 4.83	7.83	270.00± 9.35	7.38
abdominal fat	60.00± 21.21	1.67	52.33± 11.37	1.37	128.33± 53.19	3.51
Paws	148.33± 8.9	4.15	138.33± 12.42	3.63	131.67± 12.42	3.60

Table 5

Weight of internal organs of male birds of experimental groups

Indicators	**Group**					
	1st		**2nd**		**3rd**	
	g	**% of the total**	**g**	**% of the total**	**g**	**% of the total**
Age 14 weeks						
Average live weight (LW), g	3573.33± 129.15	100	3808,33± 144,15	100	3656.67± 45.60	100
Average weight (g):						
Liver	51.67±4.08	1.55	59.41±2.04	1.56	58.33±5.40	1.60
muscular stomach	55.39±3.54	1.43	55.0±3.54	1.44	53.33±5.40	1.46
Heart	20.37±0.06	0.57	21.67±4.08	0.57	20.00±0.05	0.55
spleen	5.20±0.14	0.14	5.00±0.13	0.13	5.10±0.11	0.14

The chemical composition of the pectoral muscles and thigh muscles of the male cocks of the experimental groups at the age of 14 weeks was analyzed (Table 6). As can be seen from the table, although there was some numerical difference in individual indicators of the chemical composition, it was statistically insignificant. The moisture content of the pectoral muscles and thigh muscles decreased with age, and the moisture content of the pectoral muscles of the male cocks fed a diet with a lower crude protein content (group 3 compared to the first) at the age of 14 weeks was 0.4% lower. With age, the crude protein content in the pectoral muscles increased. The difference between its content in the pectoral muscles of the male cocks of 14 and 8 weeks of age reached 1.1%. No similar trend was observed for the protein content in the pectoral muscles. The content of crude lipids in thigh muscles was 1.9-2.0 times higher than in pectoral muscles. The pH of thigh muscles was 3.7-6.0% higher than the pH of pectoral muscles.

Table 6

Chemical composition of meat of male chickens of experimental groups

Chemical composition indicators, %	1st		2nd		3rd	
	Chest muscles	Thigh muscles	Chest muscles	Thigh muscles	Chest muscles	Thigh muscles
14 weeks						
Water	73.5±0.84	74.6±1.12	73.7±0.98	74.6±0.76	73.9±0.97	74.5±1.05
Crude protein	24.2 ± 2.10	20.2 ± 1.95	24.1 ± 2.13	20.1 ± 1.90	24.0 ± 2.05	20.0 ± 1.85
Crude lipids	1.1±0.50	2.2±0.63	1.1±0.45	2.2±0.98	1.2±0.44	2.3±0.72
Ash	0.9±0.12	1.0±0.09	0.9±0.15	1.0±0.12	0.9±0.09	1.0±0.12
pH	5.94±0.18	6.20±0.13	6.00±0.16	6.15±0.14	5.96±0.17	6.12±0.15

With the participation of 10 tasters, a sensory evaluation of samples of pectoral muscles and thigh muscles of male chickens of the experimental groups was carried out. The results of the sensory evaluation of the obtained meat are shown in Table 7. Also, no significant differences were found for any sensory indicator. The sensory perception of color, as well as smell, taste, texture, juiciness and overall impression were between the indicators “slightly better” (6 points), “no differences from the control” (5 points) and “slightly worse than control” (4 points).

Table 7

Results of sensory evaluation of samples of pectoral muscles and thigh muscles of male roosters

Group	n	Color	Scent	Taste	Texture	Succulence	Overall impression
14 weeks							
Chest muscles							
1st	10	5.1±0.13	5.0±0.20	5.2±0.20	5.0±0.00	4.8±0.20	5.2±0.20
2nd	10	4.9±0.28	5.1±0.20	5.0±0.21	5.0±0.00	5.0±0.00	5.0±0.00
3rd	10	5.0±0.20	4.9±0.00	5.1±0.22	5.1±0.20	5.2±0.20	5.0±0.00
Thigh muscles							
1st	10	4.8±0.20	4.8±0.20	5.0±0.00	5.0±0.26	5.1±0.16	5.0±0.00
2nd	10	5.1±0.28	5.0±0.00	5.2±0.20	5.1±0.00	5.0±0.00	5.0±0.13
3rd	10	5.0±0.20	5.2±0.20	5.2±0.20	5.1±0.13	5.1±0.16	5.2±0.20

Discussion . Our studies studied the effect of three levels of protein in the diet on productive indicators, slaughter characteristics and the mass of internal organs of male chickens of the combined direction of productivity, divided by sex at one-day age. Additionally, an analysis of the chemical composition of the pectoral and thigh muscles was conducted.

It was found that in the starting period (1–4 weeks) the largest live weight was in the chickens of the first group, which received a diet with the highest level of crude protein in the experiment (23%). At the same time, the difference in live weight compared to other groups did not reach statistical significance. Feed conversion during this period was also the best in the first group: 4.2% lower than in the second and 8.4% lower than in the third group.

Similar patterns regarding the effect of protein levels on poultry of different genotypes were described by Chodová et al. (2021), who found that a decrease in protein levels in the diet inhibited growth and increased feed intake to a greater extent in fast-growing genotypes (Ross 308) than in slow-growing ones (ISA Dual). A decrease in protein negatively affected the European coefficient of productivity in fast- and medium-growing chickens (-10% and -6%, respectively), while no significant effect was observed in slow-growing ones. At the same time, slaughter yield and chemical composition of carcasses did not change significantly, but slow-growing chickens were characterized by a higher content of dry matter and crude protein and a lower content of fat and cholesterol.

Throughout the entire growing period, the best feed conversion was also observed in the first group, while the worst was in the third group with the lowest protein level. Over 14 weeks of growing, feed consumption per 1 kg of live weight gain in the second group exceeded the first by 2.3%, and in the third by 3.5% compared to the first and by 1.1% compared to the second group.

Similar results were obtained by Fanatico et al. (2008), who investigated the effects of diets with different levels of protein under conditions of keeping with and without walks in cockerels of fast- and slow-growing genotypes. The authors found that a decrease in protein levels negatively affected growth and feed conversion in both genotypes, and in slow-growing birds, pectoral muscle yield was additionally reduced. It was also found that access to walks contributed to an increase in live weight and improved limb condition, but worsened feed conversion due to increased motor activity, which highlights the complex interaction between protein nutrition level and housing technology.

Our studies have shown that the advantage of male birds of the first group in terms of live weight persisted until 10 weeks of age, but it was statistically significant only at 8 weeks of age. At 12 and 14 weeks of age, the highest live weight (without a statistically significant difference) was in male birds of the third group, which received a diet with the lowest level of crude protein (15% in the finishing period).

In experiments by other authors (Koreleski et al., 2008; Koreleski et al., 2009; Akbari Moghaddam Kakhki et al., 2020) when growing hybrid dual-purpose cockerels on diets with different protein levels, no significant differences in live weight were found after 83 days of fattening. Data on feed intake and conversion were ambiguous: in some cases, the indicators increased with increasing protein levels, while in others, the difference was implausible.

An important stage of the work was the analysis of the chemical composition of the meat of Birkiv meat-egg breeding cockerels at the age of 8, 10 and 14 weeks. It was found that with age the crude protein content in the pectoral muscles gradually increased (the difference between 14 and 8 weeks of age reached 1.1%), while for the thigh muscles no such clear trend was found. The crude lipid content in the thigh muscles was 1.9–2.0

times higher than in the pectoral muscles, and the pH value of the thigh exceeded the pH of the pectoral muscles by 3.7–6.0%.

Similar results were obtained by Urban et al. (2018), who investigated the effect of three protein levels in isoenergetic diets on the performance and chemical composition of ISA Dual male cockerels. The authors did not find significant differences between groups in live weight and feed conversion, and did not establish the effect of protein level on the content of protein, fat, calcium and phosphorus in carcasses. This allowed them to conclude that it is possible to reduce protein levels without negatively affecting performance and meat quality.

Analysis of the chemical composition of meat of Birkiv meat-egg breeding cocks at the age of 8, 10 and 14 weeks showed only insignificant numerical differences between the groups, which were not statistically confirmed. With age, a decrease in muscle tissue moisture was observed: in the pectoral muscles by 0.3–1.0%, in the thigh muscles by 0.2–0.5% compared to 8 weeks of age.

Similarly, Torres et al. (2019), studying cockerels of different genotypes (Bresse Gauloise, Canarian, Dominant Red Barred) under free-range conditions, found significant differences in growth rate and age at slaughter (15–22 weeks), but without significant changes in the chemical composition and fatty acid profile of pectoral muscles.

Thus, the results obtained indicate that the level of protein in the diet significantly affects productive indicators, especially in early growth periods, while its effect on the chemical composition of meat is less pronounced and largely depends on the genotype and conditions of detention.

Conclusions:

1. The zootechnical indicators, slaughter characteristics and chemical composition of meat of male chickens of domestic breeds of chickens of the combined direction of productivity were determined depending on feeding rations with different levels of protein in the starting (23% - 1st group, 21.5% - 2nd group and 20% - 3rd group) and finishing (respectively 21%, 19% and 17%) periods.

2. According to the results of cultivation The advantage of male birds of the 1st experimental group in terms of live weight compared to other groups persisted until 10 weeks of age. At 8 weeks of age, it was statistically significant ($P < 0.05$) only between chickens of groups 1 and 2. At 12 and 14 weeks of age, the cockerels of group 3 had the largest live weight, although the difference was insignificant and statistically insignificant.

3. According to the data of slaughter at the age of 14 weeks 90.39% - 89.98%. The slaughter yield of semi-gutted carcasses was higher than that at a fattening period of 8 weeks, by 3.96-3.74%.

4. Analysis of the chemical composition of the meat of male roosters of the experimental groups showed that with age the moisture content of the pectoral muscles in the 3rd group decreased compared to the first, it was lower by 0.4% at 14 weeks, but the crude protein content increased by 1.1% compared to 8 weeks. The crude lipid content in the thigh muscles was higher than in the pectoral muscles by 1.9-2.0 times. The pH of the thigh muscles was higher than the pH of the pectoral muscles by 3.7-6.0%. No significant differences were found for any sensory parameter.

5. The feed conversion ratio throughout the entire period of cockerel rearing was numerically better in group 1 and worst in group 3. However, if after 8 weeks of rearing the difference in this indicator between these groups was 9.9%, then it decreased and at 14 weeks of age was only 3.5%.

6. Feed consumption per 1 kg of live weight gain in the second group was higher compared to the 1st group by 2.3%, in the 3rd group it was higher compared to the 1st group by 3.5%, and compared to the 2nd group by 1.1%.

7. The cost of feed consumed per 1 kg of live weight gain in the 2nd group was lower compared to the first group by 9.86%, in the 3rd group it was lower compared to the 1st group by 22.18% and by 13.64% compared to the 2nd group , which indicates the economic feasibility of fattening. cockerels on low-protein diets.

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