

EFFECT OF MULTI-PHASE FEEDING ON GROWTH, MAIN CARCASS PARTS, AND NITROGEN CONTENT IN FAECES OF BROILER CHICKENS

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Abstract: The objective of this paper is to investigate the effect of multi-phase feeding, i.e. the effect of different mash feeds with multi-phase protein reduction, on growth, main carcass parts and nitrogen content in faeces of broiler chickens. The experiment was conducted on 1216 chickens of Ross 308 provenience, separated by sex. The experiment lasted for 42 days and the standard technology was used. The groups differed in a type of a mash (treatment) given in the starter period, as follows: T1 (control group) was given a mash with 23% crude proteins from day 1 to day 21; T2 – a mash with 23% proteins from day 1 to day 7, followed by a mash with 21.5% proteins given from day 7 to day 21; T3 – a mash with 23% proteins from day 1 to day 14, followed by a mash with 21.5% proteins given from day 14 to day 21; T4 – mashes changed every three days, having 23%, 22.55%, 22.10%, 21.65% , 21.20%, 20.75% and 20.30% of crude proteins, respectively. Slaughtering performance was investigated on a total of 64 broiler chickens, with eight male and eight female chickens used separately for each of the treatments. Nitrogen content in faeces was determined using the pooled sample of faeces. The obtained results showed some differences in the average daily growth of the male and female chickens when comparing the control (T1) and the experimental groups. Those differences were not statistically significant. However, when comparing the male-only groups, it was determined that the experimental group T4 had statistically significantly higher growth than T2 and T3 group. The effect of the multi-phase feeding programme on the breast, thigh and drumstick share of both male and female broilers was not significant. The applied multi-phase feeding programmes resulted in a reduction in the nitrogen content in the faeces. Considering the obtained results, it can be concluded that the multi-phase feeding programmes had no negative effect on the growth and slaughtering performances

of broilers. This goes in favour of these programmes, since they can result in some positive economic and environmental effects of production.

Key words: broiler, sex, multi-phase feeding, growth, main carcass parts, nitrogen

Introduction

Some research has indicated that broiler requirements for proteins and amino acids change over time, so a constant use of one diet for a long time would result in a surplus or deficiency of nutrients in the most of the growth period. In respect of this, *Belyavin (1999)* suggests that broilers during the period of growth should be given more different diets, basing their diet on multi-phase feeding programmes. These programmes are important in terms of diet optimization, production efficiency and environmental control. Multi-phase feeding is based on meeting nutrient requirements of broilers at specific points of their life cycle to optimize diets, i.e. to “match” mash feed ingredients with nutrient requirements of broilers in certain stages of growth. Pointing out the problem of accuracy when defining those requirements, *Ferket et al. (2002)* state that feeding requirements are like “moving targets”, having in mind considerable genetic variations in characteristics of growth, especially when it comes to protein retention. According to *Eits (2004)*, proteins are important nutrients of broiler diets, because they affect production performances, feed costs and nitrogen excretion. Proteins are most important for poultry/broiler growth, feed conversion efficiency and the quality of carcass (*Saharei, 2013*). Some research has indicated that mashes with reduced protein content do not affect body weight, but do affect fattening efficiency (*Warren and Emmert, 2000; Saleh et al., 1996*). Beside studying the effect that broiler mashes with reduced protein content have on production performances, the subject-matter of many authors has been the effect on slaughtering performances – carcass yields (*Smith et al., 1998; Saleh et al., 2004*), and the yield and share of individual carcass parts and abdominal fat (*Acar et al., 1991; Nikolova and Pavlovski, 2009*). *Kidd et al. (2004)* conducted research on diet with different protein levels given to broilers in the first week of age. It was determined male chickens were more sensitive to reduced levels of amino acids in their diet. A high nutritional value of the diet in the early period had a positive effect on increasing breast meat share, while reduced nutrition value resulted in increased fat. Studying the references on multi-phase feeding can show how complex this area is and research often cover the environmental aspect as well (*Bregendahl et al., 2002, Gutierrez et al., 2008*). Research imply that nitrogen excretion is directly related to protein content in mashes and, according to *Ferguson et al. (1998)*, manipulations in broiler diets can reduce nitrogen content in manure, with the retaining of acceptable production performances. The objective of this paper is to investigate

the effect of multi-phase feeding, i.e. the effect of different mash feeds with multi-phase protein reduction, on male and female broilers, the yield and share of the most valuable carcass parts, and nitrogen content in faeces as well.

Materials and Methods

The experiment was conducted on an experimental farm of the Faculty of Agriculture in Novi Sad, on 1216 chickens of Ross 308 provenience, i.e. 608 individually marked chickens of each sex. The chickens were put in 32 boxes (four boxes per treatment). Each box contained 38 chickens. The standard feeding technology was applied for 42 days. *Ad libitum* feeding was conducted, in four treatments: T1 (control group) was given a mash with 23% crude proteins from day 1 to day 21; T2 – a mash with 23% proteins from day 1 to day 7, followed by a mash with 21.5% proteins given from day 7 to day 21; T3 – a mash with 23% proteins from day 1 to day 14, followed by a mash with 21.5% proteins given from day 14 to day 21; T4 – a mash with 23% proteins on day 1, 2 and 3, a mash with 22.55% proteins on day 4, 5 and 6, a mash with 22.10% proteins on day 7, 8 and 9, a mash with 21.65% proteins on day 10, 11 and 12, a mash on 21.20% proteins on day 13, 14 and 15, a mash with 20.75% proteins on day 16, 17 and 18, and a mash with 20.30% proteins on day 19, 20 and 21.

The diets were based on maize-soybean, and the multi-phase mashes were made by combining two base diets – a mash with 23% proteins and 13 MJ per kg metabolic energy and a mash with 20% proteins and 13.3 MJ per kg metabolic energy. The treatments differed in protein levels but also in other nutrients, depending on the proportional share of these two diets, whose ratio changed according to the aforementioned feeding programme. After 21 days, all the chickens were fed in the same way, from day 21 to 35 with the 20% protein mash, and from day 35 to 42 with the 18% protein mash.

In the experimental period, the body weight of the chickens was monitored by individual measuring on day 1 and then on a weekly basis, from the first to the sixth week of age. Based on differences in body weight, the data on average daily growth were calculated on a level of the whole experiment.

To investigate slaughtering performances, eight 42-day old chickens were taken from each group. The testing was conducted on 64 chickens – 32 chickens of each sex. The chickens were processed in line with *the Rulebook on Quality of Poultry Meat (1981)*. The carcasses and individual carcass parts were measured with a precision balance, $\pm 0.1\text{g}$ accuracy. When calculating the share of individual carcass parts, they were compared to the pre-slaughter body weight.

Chemical analysis and determination of nitrogen content were conducted on the pooled sample of faeces, formed by collecting the excreted faeces from the experimental boxes. The faeces were collected using a wooden box with wire flooring and a plastic pad, where the chickens were held during the sampling. The

nitrogen content in the faeces was analysed at the Laboratory for testing animal feed quality within the Faculty of Agriculture in Novi Sad, and determined according to the method no. 7 of *the Rulebook on Sampling Methods and Methods of Physical, Chemical and Microbiological Analyses of Animal Feeds (1987)*.

The data were processed using “STATISTIKA” computer programme, ANOVA/MANOVA and LSD post-hoc test.

Results and Discussion

Considering the obtained results, it was concluded that the applied multi-phase feeding programmes had no negative effect on the growth and slaughtering performances of broilers, which goes in favour of their use, since these programmes can result in positive economic and environmental effects of broiler production.

Table 1 shows the significance of effects the main factors had on the average daily growth of the male/female broiler chickens, for the whole experiment. Feed and sex as variability factors did have a statistically significant effect on the average daily growth, while a feed x sex interaction was not determined.

Table 1. Daily growth (g)

Period	Measures of variation	Average daily growth (g)										
		Male chickens				Female chickens				Factor		
		T1	T2	T3	T4	T1	T2	T3	T4	Sex	Feed	SxF
1-42	\bar{x}	47.98 ^{ab}	47.24 ^b	47.12 ^b	48.84 ^a	45.77	45.14	44.98	45.74	**	**	NS
	Sd	4.61	5.12	5.20	5.35	4.67	4.93	4.49	4.56			

^{a-b} Values within a row without a common letter in their superscripts are statistically significantly different ($P < 0.05$)

** Statistically significant ($P < 0.01$)

NS Not significant

For both male and female chickens, determined differences among the control (T1) and the experimental groups were not significant. When comparing the experimental groups of female chickens, however, it was determined that T4 achieved statistically significantly higher growth than T2 and T3 groups. This result shows that in T4 treatment the production performances of broilers, i.e. the average daily growth and body weight, manifested better results when proteins were gradually reduced every three days, compared to the programmes in which the reduction started after seven or 14 days. The obtained result is in line with the basic concept of multi-phase feeding, according to which mashes should be changed several times to achieve better compatibility with nutrient requirements of

broilers and improve feed conversion efficiency (Pope et al, 2002). Unlike the male groups, there were no statistically significant differences expressed in the female groups.

The obtained results, according to which male chickens reacted differently than female chickens, can relate to different nutrient requirements of broilers, depending of sex. Different reactions of sexes to phase feeding programmes were determined by Buteri et al. (2009). These authors studied the effects of different multi-phase feeding programmes on male and female chickens of Ross 308 provenience, including programmes with three, five and 28 mashes. Moreover, a research of Kidd et al. (2004) also shows sex-related differences in results of investigated feeding programmes, in which high, medium and low content of proteins/amino acids were combined to study their effect on production performances. The male chickens showed higher sensitivity to reduction than the female chickens, which enhances the importance of sex separation of chickens.

Table 2 shows the yield and share of the most valuable carcass parts of the male and female chickens in different multi-phase feeding treatments.

The analysis of factors determined the effect of sex, yet it did not determine the effect of feed. Sex, as a variability factor, had significant effect on the yield of breast, thigh and drumsticks, and drumstick share as well. For the male chickens, higher values of thigh share were determined in all four multi-phase feeding programmes. The results are in line with a research of Bogosavljević – Bošković et al. (2004), who identified the effect of sex on thigh share, and determined significantly higher thigh share in male chickens.

Table 2. Yield and share of breast, thighs and drumsticks

Property	Measures of variation	Yield and share of main carcass parts										
		Male chickens				Female chickens				Factors		
		T1	T2	T3	T4	T1	T2	T3	T4	Sex	Feed	SxF
Breast yield (g)	\bar{X} Sd	534.67 67.23	538.83 20.00	512.83 38.77	518.67 37.54	464.83 31.20	461.00 44.32	457.33 37.07	451.67 38.66	*	NS	NS
Breast share (%)	\bar{X} Sd	24.31 2.05	24.16 1.27	23.39 1.75	23.57 1.29	24.36 1.74	24.14 1.80	23.80 1.29	23.94 1.91	NS	NS	NS
Thigh yield (g)	\bar{X} Sd	205.00 16.82	214.50 8.87	212.83 12.56	205.17 13.53	166.83 9.66	163.83 11.11	176.50 19.39	166.23 6.12	*	NS	NS
Thigh share (%)	\bar{X} Sd	9.36 0.77	9.61 0.44	9.70 0.44	9.32 0.19	8.74 0.40	8.59 0.40	9.19 0.86	8.83 0.50	*	NS	NS
Drumstick yield (g)	\bar{X} Sd	254.67 12.80	252.17 12.38	247.17 20.91	260.50 21.66	206.83 12.54	211.33 19.33	214.67 19.17	211.17 18.96	*	NS	NS
Drumstick share (%)	\bar{X} Sd	11.63 0.85	11.30 0.53	11.26 0.75	11.81 1.05	10.85 0.80	11.07 0.78	11.17 0.72	11.19 0.91	NS	NS	NS

* Statistically significant (P<0.05)

NS Not significant

For both male and female chickens, when comparing the control T1 and the experimental groups, and the experimental groups themselves, no statistically significant differences were found in the yield and share of breast, thigh and drumsticks, which implies that the multi-phase feeding programme had no effect. The results are in line with a research of *Rezaei and Hajati (2010)* in terms of the fact that reducing nutritional value of mashes in the starter period had no effect on carcass content, and the share of breast and thighs.

Protein reductions in the mashes were not drastic, so they did not have a significant effect on the yield and share of the main carcass parts; yet the chickens of T1 group, both male and female, had the highest breast share. The result can relate to the one of *Watkins et al. (1993)*, according to which the largest breast share was determined in a group fed with the starter mash for 21 days of the starter period, while the smallest breast share was found in a group fed with the starter mash for the first seven days only. Research of *Kidd et al. (2004)* also confirms that larger reductions of proteins in diets have a negative effect on breast yield.

Dry matter content and nitrogen content in faeces of both male and female chickens, in different treatments in the starter period (from the 1st to the 3rd week) were shown in table 3.

Table 3. Dry matter and nitrogen content in faeces

Week	Property	Chemical composition of faeces (%)							
		Male chickens				Female chickens			
		T ₁	T ₂	T ₃	T ₄	T ₁	T ₂	T ₃	T ₄
1	Dry matter	16.96	16.71	19.65	18.59	19.73	20.42	19.54	16.82
	N in DM	5.01	4.82	4.87	4.65	5.64	5.37	5.57	4.61
2	Dry matter	17.46	18.31	18.03	14.67	16.82	18.56	16.70	17.00
	N in DM	5.40	5.38	5.27	5.17	5.51	5.44	5.18	4.85
3	Dry matter	16.59	19.31	16.62	18.62	17.33	16.25	15.75	17.59
	N in DM	5.32	5.30	5.29	4.19	5.48	4.87	4.94	5.08

Recorded nitrogen values in the faeces are relatively similar, with a certain tendency for decreasing of nitrogen content when reducing protein content in the mashes. However, differences among the groups are not so pronounced to make some of the programmes defined as optimal from the aspect of environmental control. Phase feeding does not always result in reduction of nitrogen excretion, as it was proved in a research of *Gutierrez et al. (2008)* who simultaneously studied three programmes of continual multi-phase feeding of broilers in the starter period.

Nasril (2003) obtained similar results when studied the continual multi-phase feeding of broilers in the starter period. According to *Coufal (2005)*, nitrogen emission in broiler production also varies, depending on a period, i.e. a season of the year. The research implies a need for further studying of these feeding programmes in terms of their effect on the environment.

Conclusion

Multi-phase feeding comprised several broiler mashes used to adjust the content of feeds to the requirements of broiler chickens, thus improving feed conversion, increasing production efficiency and decreasing nitrogen excretion in faeces. Considering the obtained data, it can be concluded that the feeding programmes applied in the starter period on chickens of both sexes did not have a statistically significant effect on the average daily growth and share of the most valuable carcass parts (breast, thighs and drumsticks). This goes in favour of the use of multi-phase feeding, one of objectives of which is the reduction of input costs through reducing the protein content, without negative impact on performances. At the same time, multi-phase reduction of protein content every three days resulted in slightly lower values of nitrogen in faeces of both male and female chickens, which can be important in terms of environmental control.

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Uticaj multifazne ishrane brojlera na prirast, osnovne delove trupa i sadržaj azota u fecesu

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Rezime

Cilj rada je ispitivanje uticaja multifazne ishrane, odnosno različitih smeša za ishranu brojlera u kojima je sadržaj proteina višefazno smanjen, na prirast, osnovne delova trupa i sadržaj azota u fecesu.

Ispitivanje je izvedeno na 1216 pilića provenijence Ross 308, razdvojenih po polu. U oglednom periodu od 42 dana primenjena je standardna tehnologija. Razlika između grupa (tretmana) bila je u tipu smeša za ishranu u starter periodu, a prema sledećem programu: T1 (kontrolna grupa) - ishrana smešom sa 23% sirovih proteina u trajanju od 1. do 21. dana; T2 - ishrana od 1. do 7. dana smešom sa 23% i od 7. do 21. dana sa 21,5% proteina; T3 - ishrana od 1. do 14. dana smešom sa 23% sirovih proteina i od 14. do 21. dana sa 21,5% proteina; T4 - ishrana smešama sa dinamikom promene na svaka 3. dana, odnosno sa 23% , 22,55% , 22,10%, 21,65% , 21,20%, 20,75% i 20,30% sirovih proteina. Ispitivanje klaničnih osobina,

obavljeno je na ukupno 64 brojlera, odnosno na po 8 pilića oba pola, za svaki tretman. Sadržaj azota u fecesu određen je na zbirnom uzorku fecesa.

Prema dobijenim rezultatima, kod pilića muškog i ženskog pola, utvrđene razlike u prosečnom dnevnom prirastu, između kontrolne (T1) i oglednih grupa nisu bile na nivou statističke značajnosti. Međutim, poređenjem oglednih grupa međusobno, kod pilića muškog pola utvrđeno je da je ogledna T4 grupa ostvarila statistički značajno veći prirast u poređenju sa T2 i T3 grupom. Uticaj programa multifazne ishrane na prinos i udeo grudi, bataka i karabataka, kod pilića oba pola, nije bio signifikantan. Primenjeni programi multifazne ishrane rezultirali su izvesnim smanjenjem sadržaja azota u fecesu.

Na osnovu dobijenih rezultata može se zaključiti da programi multifazne ishrana brojlera nisu imali negativan uticaj na prirast i klanične performanse, što ide u prilog njene primene, s obzirom da se ovim programima mogu ostvariti pozitivni ekonomski i ekološki efekti proizvodnje.

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