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EFFECT OF DIETARY PROTEIN LEVEL AND LENGTH OF FATTENING PERIOD ON DRESSING PERCENTAGE AND CARCASS CONFORMATION IN BROILER CHICKENS

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Abstract: This study analyses the effect of different protein levels in broiler feeds (supplemented with protease) and different lengths of fattening period on some parameters related to dressed carcass quality. Medium-growing Master Gris broiler chickens were used in a fattening trial lasting 63 days. At slaughter, dressing percentages and abdominal fat percentages were determined based on traditionally dressed carcass weights and abdominal fat weights of broilers at 49 and 63 days, and conformation indices were calculated based on absolute conformation measurements. Results showed that dietary treatment had an effect only on one relative conformation measurement – body weight/shank length in chickens at 49 days, as control broilers had higher values of this index compared to chickens receiving feeds containing reduced levels of crude protein and protease supplementation (0.2% or 0.3%). Length of fattening period affected almost all studied parameters, except breast angle, dressing percentage of traditionally dressed carcass and abdominal fat percentage.

Key words: broiler chickens, protease, length of fattening period, traditionally dressed carcass, conformation measurement

Introduction

Knowledge of genetic and non-genetic factors affecting broiler meat quality and production is the key to successful poultry meat production. The main goal of modern broiler production is maximum utilisation of the genetic potential of fast-growing broiler strains.

Nutrition is an important factor governing meat quality, with dietary protein level having the greatest influence. The need for reducing the negative environmental impact

of poultry nutrition requires feed quality improvement to minimise the entry of waste products of the digestive process (ammonia, phosphates, etc.) into the environment.
Broiler slaughter weight has a large effect on body conformation traits (*Pavlovski and Mašić, 1983*), which are, moreover, very often directly associated with the weight and distribution of muscles, primarily those of the breast, thighs and drumsticks *(Pavlovski et al., 2006).*
Moderate- and slow-growing broilers have been selected for long fattening periods under semi-intensive and free-range production systems; therefore, they have longer shanks. Furthermore, prolonged fattening leads to a considerable improvement in body conformation traits in these broilers compared to young chickens, with the only significant difference, in most cases, found in shank length (*Pavlovski et al., 2007).*
With aging, body weight and dressed carcass weight increase, while dressing percentage decreases *(Bogosavljević-Bošković et al., 2008)*. In addition, prolonged fattening causes an increase in the proportion of major primal cuts i.e. breast, thighs and drumsticks (*Milićević, 2006*), which is, however, not always the case in slow-growing strains *(Grashorn and Clastermann, 2002)*.
As found by *Zerehdaran et al. (2005)*, the genetic correlation between body weight and abdominal fat percentage at 70 days of age was higher than at 48 days; the increase in growth at 48 days was accompanied by an increase in valuable parts, whereas this increase at 70 days was accompanied by an increase in abdominal fat percentage.
There is a relatively large body of literature on the quality of meat obtained from fast-growing broilers. However, meat quality of medium-growing broilers has not been extensively studied. There is also a scarcity of literature data on the nutritional requirements of moderate growth broilers and medium-growing broilers. Crude protein requirements of slow-growing chickens are lower than those of fast-growing broilers *(Morris and Njuru, 1990)*, whereas dietary lysine requirements are the same regardless of growth rate *(Han and Baker, 1993).*
It is for the above reason that this study focused on the effect of protein levels in diets supplemented with protease on the dressing percentage of the traditionally dressed carcass and body conformation in medium-growing Master Gris broilers at 49 and 63 days of age.

Materials and methods

During 63 days of the experimental fattening period, 300 day-old medium-growing Master Gris broilers were randomly allocated to 3 groups, each consisting of 100 chickens. Stocking density was 10 chickens/m^2. Broilers were fed ad libitum. During the experiment, optimum air temperature and humidity conditions were provided in the poultry house.

Dietary treatments

Broiler feeding involved three stages: starter (the first 3 weeks), grower (22-35 days) and finisher (from 36 days until the end of the experiment). Broilers received complete feeds based on maize and soybean products (soybean meal and full-fat soybean grits), designed for fast-growing broilers (Table 1). Across groups, at all fattening stages, control broilers were fed diets containing standard levels of crude protein, whereas experimental E-I and E-II chickens received diets with crude protein amounts reduced by 4% and 6%, respectively, compared to the normal protein level (through reduction in the amount of soybean meal used), and supplemented with protease (Ronozyme ProAct, DSM, The Netherlands) at 0.2 % and 0.3%, respectively.

Table 1. Nutrient composition of diets for treatments[1]

	Starter phase			Grower phase			Finisher phase		
Treatments	C	E-1	E-2	C	E-1	E-2	C	E-1	E-2
ME, kcal/kg	3.081	3.100	3.112	3.157	3.174	3.183	3.181	3.198	3.207
Crude proteins, %	22.59	21.72	21.24	18.99	18.22	17.84	17.16	16.45	16.09
Crude fats, %	5.59	5.55	5.70	5.67	5.73	5.76	5.55	5.61	5.64
Ca, %	0.96	0.95	0.95	0.91	0.91	0.90	0.90	0.89	0.89
Available P, %	0.44	0.44	0.43	0.40	0.40	0.40	0.39	0.39	0.39
Total lysine, %	1.33	1.27	1.24	1.15	1.10	1.08	1.05	1.00	0.98
Total methionine+cystine, %	0.92	0.90	0.89	0.91	0.89	0.88	0.86	0.84	0.83
Total threonine, %	0.90	0.87	0.85	0.75	0.72	0.70	0.67	0.64	0.63
Total tryptophane, %	0.30	0.29	0.28	0.23	0.22	0.21	0.20	0.19	0.18

[1]Treatments: C-control group, standard broiler diet, without protease; E-I- broilers fed a diet with 0.2% protease (Ronozyme ProAct) supplementation; E-II broilers fed a diet with with 0.3% protease (Ronozyme ProAct) supplementation

Data collection

Ten male and 10 female broilers at 49 and 63 days of age were randomly chosen from each group, individually tagged, weighed after 10 hours of fasting and slaughtered.

At slaughter, weights of traditionally dressed carcass and abdominal fat were measured. Thereafter, the carcasses were dissected into breast, drumsticks, thighs, wings, back and pelvis as primal cuts (*Commission Regulation (EC) No. 543/2008*), and evaluated for conformation traits: breast angle BA (degrees), shank length SL (mm), keel length KL (mm), breast depth BD (mm) and thigh girth TG (mm) as indicators of major carcass parts and their development (*Pavlovski and Mašić, 1983*). To eliminate the influence of body weight on these traits, conformation indices (body weight/shank length (g/mm) BW/SL, body weight/keel length (g/mm) BW/KL, body weight/breast depth (g/mm) BW/BD and body weight/thigh girth (g/mm) BW/TG) were determined.

Statistical analysis

Data were statistically analysed by conventional methods, using the statistical software *Statistica for Windows Release 6.0 (1995)*.
The mathematical model of a two-way analysis of variance (3x2 design – 3 feeding treatments-FT and 2 fattening periods -FP) was used to test the significance of differences for meat quality parameters.
The significant differences detected by the analysis of variance (ANOVA) and the results of the expected value of the F-ratio were assessed by the LSD test ($P<0.05$).

Results and Discussion

Table 2 presents slaughter body weights of Master Gris broilers, traditionally dressed carcass weights, dressing percentages, abdominal fat weights and abdominal fat percentages of traditionally dressed carcasses.

Table 2. Weights and dressing percentages of traditionally dressed carcasses of broilers across experimental groups

Treatment			Slaughter weight, gr	Traditionally dressed carcass weight, gr	Dressing percent of TD carcass, %	Adbominal fat, gr	Abdominal fat, %
Protease	Fattening period, days						
No	49	$\bar{x}$	2570.25^{b}	2200.53^{b}	85.61	43.34^{b}	1.71
		Sd	192.76	165.87	1.97	13.57	0.58
	63	$\bar{x}$	3387.00^{a}	2903.50^{a}	85.72	63.82^{a}	1.91
		Sd	406.19	382.80	1.99	12.60	0.43
0.2%	49	$\bar{x}$	2452.00^{b}	2125.70^{b}	86.69	40.82^{b}	1.68
		Sd	210.21	184.15	1.20	11.46	0.50
	63	$\bar{x}$	3334.00^{a}	2851.66^{a}	85.53	64.32^{a}	1.96
		Sd	361.21	338.71	1.80	15.03	0.53
0.3%	49	$\bar{x}$	2513.50^{b}	2156.87^{b}	85.81	46.08^{b}	1.86
		Sd	227.32	192.04	1.25	11.73	0.54
	63	$\bar{x}$	3302.50^{a}	2830.97^{a}	85.72	61.85^{a}	1.91
		Sd	388.12	354.65	1.40	15.58	0.58
p-value							
Source of variation							
Protease			0.423	0.544	0.446	0.891	0.777
Fattening period			0.001	0.001	0.114	0.001	0.067
Protease x fattening period			0.790	0.920	0.196	0.433	0.602

TD- "traditionally dressed"
[a-b] Means followed by different superscript letters within columns differ significantly ($P<0.05$)

As indicated by Table 2, dietary treatments showed no differences in carcass quality parameters ($p>0.05$). Prolonged fattening resulted in an increase in body weights of Master Gris broilers by about 830 gr on average ($p<0.05$). Also, traditionally dressed

carcass weights increased by about 700gr on average ($p<0.05$), while similar values were recorded for the dressing percentage of traditionally dressed carcass regardless of broiler age ($p>0.05$). Prolonged fattening caused an increase in abdominal fat weight ($p<0.05$), while no significant changes were found in abdominal fat percentage, similarly to the dressing percentage ($p>0.05$).
Body weight of broilers is largely affected by rearing system and diet. In the present study, Master Gris broilers achieved somewhat higher body weights compared to the performance data provided by the producer (*Master Gris, 2004*), which was most likely due to much more intensive nutrition (broilers received feeds designed for fast-growing strains). However, *Blagojević (2011)* reported considerably lower average body weights of Master Gris broilers at 49 days (1434.25 g) and at 63 days (1626.40 g) under extensive free range production conditions.
In this study, values for the dressing percentage of the traditionally dressed carcass were somewhat higher than those determined by *Blagojević et al. (2009)* - 83.68% in Master Gris broilers at 91 days of age, along with a somewhat higher abdominal fat content (3.16%).

Absolute body conformation measurements (shank length, keel length, breast depth, breast angle and thigh girth) for broilers belonging to different age groups are provided in Table 3.

Table 3. Body conformation (absolute values) of broilers across experimental groups

Treatment			SL mm	KL mm	BD mm	BA degrees	TG mm
Protease	Fattening period, days						
No	49	$\bar{x}$	78.85[b]	117.10[b]	101.55[b]	127.10	145.65[b]
		Sd	4.28	4.65	5.50	3.04	6.88
	63	$\bar{x}$	87.65[a]	126.30[a]	109.55[a]	127.75	160.40[a]
		Sd	7.58	6.21	7.35	2.63	10.50
0.2%	49	$\bar{x}$	79.85[b]	117.95[b]	100.20	128.20	149.75[b]
		Sd	5.21	5.55	7.71	1.51	7.25
	63	$\bar{x}$	88.75[a]	126.10[a]	108.80[a]	127.45	157.65[a]
		Sd	7.64	4.85	6.77	2.39	9.66
0.3%	49	$\bar{x}$	82.95[b]	117.05[b]	102.70[b]	127.00	145.20[b]
		Sd	5.24	4.58	5.57	2.73	7.80
	63	$\bar{x}$	88.75[a]	126.55[a]	108.50[a]	128.90	156.00[a]
		Sd	7.50	5.25	6.52	7.41	7.50
p-value							
Source of variation							
Protease			0.192	0.960	0.704	0.812	0.224
Fattening period			0.001	0.001	0.001	0.389	0.001
Protease x fattening period			0.470	0.831	0.610	0.300	0.190

SL-shank length, KL-keel length, BD-breast depth, BA-breast angle, TG-thigh girth
[a-b] Means followed by different superscript letters within columns differ significantly ($P<0.05$)

Reduced dietary protein levels and protease supplementation had no effect on absolute conformation traits in the tested broilers ($p>0.05$). The 14-day prolongation of the fattening period led to increased values for all absolute conformation measurements taken ($p<0.05$), except for breast angle, which had similar values at both 49 and 63 days ($p>0.05$), consistently with the results of *Pavlovski et al. (2007)*. As the result of higher values for body weight and dressed carcass weight, body conformation scores for broilers in this study were better than in *Blagojević (2011)*, who found similar shank lengths, but much lower values for the other absolute conformation traits in Master Gris broilers at 91 days.

Relative conformation measurements – body conformation indices in Master Gris broilers across dietary treatments, are given in Table 4.

Table 4. Body conformation indices in broilers across experimental groups

Treatment			BW/SL g/mm	BW/KL g/mm	BW/BD g/mm	BW/TG g/mm
Protease	Fattening period, days					
No	49	$\bar{x}$	32.61[b]	21.93[b]	25.34[b]	17.66[b]
		Sd	1.90	1.11	1.87	1.18
	63	$\bar{x}$	38.58[a]	26.80[a]	30.87[a]	21.06[a]
		Sd	2.48	2.77	2.59	1.41
0.2%	49	$\bar{x}$	30.71[c]	20.79[b]	24.52[b]	16.36[b]
		Sd	1.65	1.45	1.85	0.89
	63	$\bar{x}$	37.55[a]	26.40[a]	30.61[a]	21.12[a]
		Sd	2.16	2.22	2.28	1.50
0.3%	49	$\bar{x}$	30.34[c]	21.46[b]	24.47[b]	17.32[b]
		Sd	2.56	1.58	1.77	1.38
	63	$\bar{x}$	37.18[a]	26.04[a]	30.38[a]	21.12[a]
		Sd	2.62	2.28	2.44	1.75
p-value						
Source of variation						
Protease			0.001	0.188	0.333	0.114
Fattening period			0.001	0.001	0.001	0.001
Protease x fattening period			0.612	0.487	0.836	0.071

BW – body weight at slaughter, SL – shank length, KL – keel length, BD – breast depth, TG – thigh girth
[a-c] Means followed by different superscript letters within columns differ significantly ($P<0.05$)

As shown in Table 4, relative conformation traits were significantly affected by length of fattening period ($p<0.05$), similarly to absolute conformation traits, carcass weight and abdominal fat weight. The prolongation of the fattening period for 2 weeks led to an increase in all absolute conformation measurements, which was in agreement with *Pavlovski and Mašić (1983)* and *Pavlovski et al. (2006).* The conformation indices were much higher, as the result of intensive production

of this strain of broilers. There are very few literature data regarding body conformation of Master Gris broilers. *Blagojević et al. (2009)* reported the following values for the same strain of broilers at 91 days of age: body weight/shank length 22.57, body weight/keel length 19.41, body weight/breast depth 19.33, body weight/thigh girth 15.27. Dietary protein level had no significant effect on body conformation indices, except on body weight/shank length in broilers at 49 days. Specifically, C broilers had significantly higher values for this index compared to E-I and E-II chickens ($p<0.05$), due to somewhat greater body weights and somewhat shorter shanks compared to E-I and E-II broilers.

Conclusion

Results showed similar responses of Master Gris broilers to dietary treatments in terms of the carcass traits analysed, given that significant difference occurred only at 49 days of the fattening trial in one relative conformation measurement – body weight/shank length (between C and E-I broilers and between C and E-II broilers). The parameters tested were considerably more affected by another factor studied – length of fattening period, which produced significant effects on all traits, except the dressing percentage of traditionally dressed carcass, abdominal fat percentage and breast angle. The prolongation of the fattening period for two weeks led to an increase in all absolute and relative conformation measurements taken, except breast angle, which had similar values for both lengths of fattening period.

Uticaj nivoa proteina u hrani i dužine trajanja tova na randman i mere konformacije trupova pilića

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Rezime

U radu je analiziran uticaj različitog nivoa proteina u hrani za tov pilića (uz dodatak enzima proteaze) i dužine trajanja tova na neke parametre kvaliteta obrađenih trupova. U ogledu je korišćen medium-growing linijski hibrid Master Gris, a ogled je trajao 63 dana. Na liniji klanja, na osnovu mase klasično obrađenog trupa i mase abdominalne masti pilića uzrasta 49. i 63.dana tova utvrđen je randman klasimično obrađenog trupa i udeo abdominalne masti, a na osnovu apsolutnih mera konformacije izračunati su indeksi mera konformacije. Rezultati ogleda su pokazali da je uticaj ispitivanih obroka ispoljio efekat samo na jednu

relativnu meru konformacije trupova – telesna masa/dužina piska kod pilića starosti 49.dana, jer su pilići iz kontrolne grupe imali veću vrednost ovog indeksa u odnosu na piliće koji su hranjeni smešama sa nižim nivoima sirovih proteina, uz dodatak enzima proteaze (0,2% ili 0,3%). Različita dužina trajanja tova uticala je na skoro sve ispitivane parametre, izuzev na veličinu grudnog ugla, randman klasično obrađenog trupa i udeo abdominalne masti.

Ključne reči: pilići, proteaza, dužina trajanja tova, klasično obrađen trup, mere konformacije

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