ISBN 978-86-82431-73-2

11th INTERNATIONAL SYMPOSIUM

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INSTITUTE FOR ANIMAL HUSBANDRY
BELGRADE - SERBIA

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Publisher
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Editor-in-Chief
Milan M. Petrović, PhD, Principal Research Fellow
Director of the Institute for Animal Husbandry, Belgrade-Zemun

Proceedings of the 11th International Symposium
Modern Trends in Livestock Production
October 11-13, 2017

EFFECT OF PROTEASE ON PRODUCTION PERFORMANCE, WEIGHTS AND PROPORTIONS OF PRIMAL CUTS AND WEIGHTS OF EDIBLE BY-PRODUCTS OF BROILERS

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Original scientific paper

Abstract: This study analyses the effect of different levels of dietary protease supplementation on the weights and proportions of primal cuts (breast, drumsticks, thighs, wings, back, pelvis) and weights of edible by-products (liver, heart, gizzard) in two strains of broilers (fast-growing Cobb 500 and medium-growing Master Gris) in a 49-day experiment. Broilers were allocated to 3 dietary treatment groups: group C (standard diet, 0% protease), group E-I (0.2% protease, crude protein level reduced by 4% compared to C) and group E-II (0.3% protease, 6% reduction in crude protein compared to C). The analysis of production performance showed lower body weights at the end of the fattening experiment, lower feed consumption and poorer feed conversion ratios in Master Gris broilers than in Cobb 500 chickens ($P<0.05$). As determined from data obtained at slaughter, the two broiler strains differed significantly in the weights and proportions of all primal cuts, except the proportion of back, as well as in the weights of all edible by-products, except gizzard. Dietary treatments had a significant effect ($P<0.05$) only on body weight and liver weight in Cobb 500 broilers belonging to E-II compared to C chickens.

Key words: broilers, protease, primal cuts, edible by-products

Introduction

Over the last twenty years, research in poultry farming has been increasingly focused on new production systems for broiler chickens as an alternative to intensive rearing of fast-growing broiler strains, short fattening periods, high stocking densities, etc.

Poultry meat obtained in these novel systems is noted and recognised for its productive traits and quality. In contrast, intensive production has undermined animal welfare, and causes increasing environmental pollution.

Moreover, previous studies have shown great variations in growth and development characteristics among broiler strains, which exhibit specific rates of growth and protein (meat) synthesis and, hence, have specific dietary requirements for protein and other nutrients. A major reason underlying variations in broiler growth and development is nutrition i.e. genotype x nutrition interaction. In addition, broiler nutrition is an important factor influencing meat quality, with the dietary protein level having the greatest effect.

Attention has been given to the production of moderate growth genotypes (*Škrbić et al., 2007, Meluzzi et al., 2009, Blagojević, 2011*), the prolongation of fattening periods (*Souza et al. 2011*), the modification of broiler diet formulations, the use of synthetic amino acids, enzymes, mycotoxin adsorbents, organic acids, probiotics (*Rahman et al., 2009, Dosković et al., 2016*), the use of free range (*Bogosavljević-Bošković et al., 2011*), etc.

The objective of this study was to compare carcass quality of two strains – fast-growing Cobb 500 and medium-growing Master Gris broilers receiving different feed formulations – standard feeds for intensive rearing and feeds containing reduced crude protein levels and supplemented with protease.

Material and methods

Two broiler strains i.e. fast-growing Cobb 500 and medium-growing Master Gris were used in the experiment, which involved 300 day-old chickens of each strain allocated to 3 experimental groups – dietary treatments.

Dietary treatments

Dietary treatments included control C diet containing standard levels of nutrients, E-I diet containing crude protein reduced by 4% relative to the control and 0.2% supplemental protease, and E-II diet containing crude protein reduced by 6% relative to the control and 0.3% supplemental protease (Table 1.). The experiment lasted 49 days. Standard fattening technology was used (10 broilers/m^2, 24-h photo schedule, ad libitum access to feed and water, starter, grower and finisher stages).

The supplementation of the protease enzyme (Ronozyme ProAct, DSM, The Netherlands) was provided through a vitamin and mineral premix.

Table 1. Nutrient composition of diets for broilers across dietary treatments

Ingredient, %	Starter stage (1 to 21 d)			Grower stage (22 to 42 d)			Finisher stage (43 to 49 d)		
Treatments	C	E-1	E-2	C	E-1	E-2	C	E-1	E-2
ME, MJ/kg	12.89	12.97	13.02	13.21	13.28	13.32	13.31	13.38	13.42
Crude proteins, %	22.59	21.72	21.24	18.99	18.22	17.84	17.16	16.45	16.09
Lysine, %	1.33	1.27	1.24	1.15	1.10	1.08	1.05	1.00	0.98
Methionine+cystine, %	0.92	0.90	0.89	0.91	0.89	0.88	0.86	0.84	0.83
Threonine, %	0,90	0,87	0,85	0,75	0,72	0,70	0,67	0,64	0,63
Tryptophan, %	0,30	0,29	0,28	0,23	0,22	0,21	0,20	0,19	0,18

Data collection

At slaughter, 20 broilers (10 females and 10 males) from each group were slaughtered and weight measurements were taken for ready-to-grill carcass, primal cuts (breast, drumsticks, thighs, back, pelvis, wings) and by-products (liver, heart, gizzard).

Statistical analysis

The data obtained were statistically analysed using *ANOVA, Microsoft STATISTICA Ver. 5.0, StatSoft Inc., 1995,* analysis of variance, F-test and Tukey's test (P<0.05).

Results and discussion

Table 2 presents productive traits of two strains of broilers at 49 days of age.

Table 2. Production performance of tested genotypes

Treatment		Body weight, g	Feed consumption, g	Feed conversion ratio, kg/kg prirasta
Hybrid	Protease	49d	1 to 49day	1 to49 day
Cobb 500	No	3001.7^{a}	5931.4^{a}	2.006^{b}
	0.2%	2960.7^{ab}	5750.1^{a}	1.971^{b}
	0.3%	2880.1^{b}	5667.2^{a}	1.998^{b}
Master Gris	No	2397.0^{c}	5570.1^{a}	2.365^{a}
	0.2%	2345.9^{c}	5477.0^{a}	2.379^{a}
	0.3%	2383.9^{c}	5350.3^{b}	2.286^{a}
p-value				
Source of variation				
Hybrid		0.001	0.002	0.001
Protease		0.051	0.103	0.379
Hybrid x Protease		0.063	0.918	0.188

$^{a-c}$ Means within a column with different superscripts differ significantly (P<0.05)

As shown in Table 2, Cobb 500 broilers had greater body weights, higher feed consumption and a lower feed intake per kg of live weight gain compared to Master Gris chickens (P<0.05).

Café et al. (2002) reported an average body weight of 2.705 – 2.748 kg and feed conversion of 2.122 – 2.134 kg feed/kg gain for Cobb 500 broilers at 49 days, and the respective values determined by *Ahmadi and Karimov (2010)* in the same strain of broilers at the same age were 2,580 – 2,698 g and 1.818 – 1.870 kg feed/kg gain. Greater body weights in the present study were primarily due to longer starter (0 to 21 days) and grower (22 to 42 days) stages compared to the abovementioned authors (0-14 days and 14-35 days, respectively), which most likely affected the feed conversion ratio. The body weights of Master Gris broilers in this research were about 400 gr higher and the amount of feed intaken per kg gain was greater than the manufacturer's data (weight 1,963gr, feed conversion 1.96-2.03kg feed/kg gain, Master Gris, 2004). Similarly, *Van Horne et al. (2004)* found a higher feed intake per unit of weight gain in slow-growing broilers than in fast-growing chickens.

These results were supported by similar findings of *Yu et al. (2007), Favero et al. (2009),* reporting no differences in feed intake per unit of gain in dietary treatments with 0.2% supplemental protease and reduced crude protein levels. However, significance in body weight occurred at 49 days between C and E-II (0.3% protease) broilers.

The weights of edible by-products of both strains of broilers are given in Table 3.

Table 3. Weights of edible by-products of broilers

Treatment		Liver,	Heart,	Gizzard,
Hybrid	Protease	g	g	g
Cobb 500	No	55.79^{a}	13.65^{a}	45.43
	0.2%	50.99^{ab}	13.78^{a}	46.10
	0.3%	49.87^{b}	12.95^{ab}	44.45
Master Gris	No	48.48^{bc}	11.77^{ab}	47.68
	0.2%	43.91^{c}	10.82^{b}	47.03
	0.3%	45.83^{bc}	11.84^{ab}	46.15
p-value				
Source of variation				
Hybrid		0.001	0.001	0.185
Protease		0.002	0.744	0.624
Hybrid x protease		0.443	0.247	0.907

a-c Means within a column with different superscripts differ significantly (P<0.05)

The data on the weights and proportions of edible by-products (heart, liver and gizzard) presented in Table 3 indicate greater heart and liver weights and lower gizzard weights in Cobb 500 broilers than in Master Gris chickens, but the effect of genotype was non-significant (P>0.05). Dietary treatments had a significant effect only on liver weight in Cobb 500 broilers belonging to group E-II compared to C chickens (P<0.05).

The weights of primal cuts (breast, drumsticks, thighs, wings, back, pelvis) are shown in Table 4.

Table 4. Weights of primal cuts of broilers

Treatment		Breast, g	Drumsticks, g	Thighs, g	Wings, g	Back, g	Pelvis, g
Hybrid	Protease						
Cobb 500	No	798.68[a]	326.45[a]	376.97[a]	261.88[a]	283.53[a]	246.21[a]
	0.2%	791.36[a]	312.57[a]	372.29[a]	252.15[a]	274.78[a]	244.96[a]
	0.3%	764.78[a]	307.96[a]	361.19[a]	253.83[a]	279.95[a]	252.22[a]
Master Gris	No	524.51[b]	277.48[b]	303.78[b]	221.74[b]	222.64[b]	211.47[b]
	0.2%	509.90[b]	264.66[b]	293.25[b]	219.16[b]	209.10[b]	200.89[b]
	0.3%	515.70[b]	265.04[b]	297.08[b]	219.18[b]	216.55[b]	205.55[b]
p-value							
Source of variation							
Hybrid		0.001	0.001	0.001	0.001	0.001	0.001
Protease		0.394	0.113	0.347	0.491	0.332	0.552
Hybrid x protease		0.554	0.921	0.633	0.799	0.950	0.608

[a-b] Means within a column with different superscripts differ significantly (P<0.05)

In line with their greater body weights, fast-growing broilers had greater weights of all primal cuts (breast, drumsticks, thighs, wings, back, pelvis) compared to medium growing broilers (P<0.05). Regardless of feed formulation, the weights of primal cuts were similar in broilers of the same strain; accordingly, no significance was exhibited by dietary crude protein reduction and protease supplementation in either strain (P>0.05).

Based on the weights of primal cuts and ready-to-grill carcass, the proportions of primal cuts were determined (Table 5).

Table 5. Proportions of primal cuts of broilers

Treatment		Breast, %	Drumsticks, %	Thighs, %	Wings, %	Back, %	Pelvis, %
Hybrid	Protease						
Cobb 500	No	33.60[a]	13.69[b]	15.83[bc]	11.02[b]	11.92	10.34[b]
	0.2%	33.93[a]	13.38[b]	15.96[abc]	10.79[b]	11.68	10.47[b]
	0.3%	33.24[a]	13.34[b]	15.47[c]	11.02[b]	12.15	10.91[ab]
Master Gris	No	28.62[b]	15.10[a]	16.53[ab]	12.08[a]	12.11	11.54[a]
	0.2%	28.90[b]	14.97[a]	16.62[a]	12.42[a]	11.86	11.40[a]
	0.3%	28.78[b]	14.77[a]	16.58[ab]	12.22[a]	12.08	11.47[a]
p-value							
Source of variation							
Hybrid		0.001	0.001	0.001	0.001	0.549	0.001
Protease		0.659	0.148	0.388	0.819	0.228	0.195
Hybrid x protease		0.785	0.845	0.431	0.051	0.782	0.134

[a-c] Means within a column with different superscripts differ significantly (P<0.05)

The proportion of breast in Cobb 500 broilers in this study was much higher than in *Café et al. (2002)* for the same strain and age, whereas the proportions of drumsticks, thighs and wings were somewhat lower. Similar data on the proportions of breast, drumsticks and thighs were found by *Ahmadi and Karimov (2010),* as opposed to *Si et al. (2004)* who determined lower breast and higher wing proportions.

The comparison between the two broiler strains suggests that slow-growing broilers had lower breast, but higher drumstick, thigh, wing and pelvis proportions (P<0.05), whereas the proportion of back was similar in both strains (P>0.05). Similarly, *Havenstein et al. (1994)* reported higher drumstick and lower breast proportions in slow-growing broilers than in fast-growing ones, and *Quentin et al. (2003)* found higher drumstick and thigh yields in slow-growing chickens, indicating that carcass composition was generally not affected by dietary treatment (different energy and protein concentrations), which was confirmed by the finding of the present study that crude protein reduction and protease supplementation had no effect on the weights and proportions of primal cuts in both strains of broilers (P>0.05).

Conclusion

The analysis of production performance showed that Master Gris broilers had lower body weights at the end of the fattening experiment – 49 days, lower feed consumption and poorer feed conversion ratios compared to Cobb 500 broilers (P<0.05). As determined from data obtained at slaughter, significant differences were found between the two strains of broilers (P<0.05) in the weights of all primal cuts, proportions of primal cuts, except breast, and the weights of all by-products, except gizzard. The effect of feed formulation was significant (P<0.05) only on the body weight and liver weight of Cobb 500 broilers belonging to E-II compared to C chickens.

Uticaj enzima proteaze na proizvodne rezultate, masu i udeo osnovnih delova trupa i masu jestivih pratećih proizvoda klanja pilića

Vladimir Dosković, Snežana Bogosavljević-Bošković, Zdenka Škrbić, Milun D. Petrović, Veselin Petričević, Simeon Rakonjac

Rezime

U radu je analiziran uticaj različite koncentracije enzima proteaze, dodate u hranu, na masu i udeo osnovnih delova trupa (grudi, bataci, karabataci, krila, leđa, karlica) i jestivih pratećih proizvoda klanja (jetra, srce, mišićni želudac) kod dva tovna hibrida pilića. U ogledu su korišćeni brzorastući hibrid Cobb 500 i medium-growing linijski hibrid Master Gris. Ogled je trajao 49 dana, a pilići oba hibrida bili su podeljeni u 3 ishranbene grupe: C group (standardni obrok, 0% enzima proteaze), E-I group (0,2% enzyme protease, uz snižen nivo sirovih proteina za 4% u odnosu na C group) and E-II group (0,3% enzyme protease, uz manji nivo sirovih proteina za 6% u odnosu na C group).

Analiza proizvodnih rezultata pokazala je da su pilići hibrida Master Gris imali manju telesnu masu na kraju tova, manju konzumaciju hrane i lošiju konverziju hrane u odnosu na piliće hibrida Cobb 500 (P<0.05). Na osnovu podataka sa linije klanja, utvrđeno je da su između ispitivanih hibrida postojale značajne razlike u masi i udelu svih osnovnih delova trupa, izuzev udela leđa, kao i masi svih pratećih proizvoda klanja, izuzev u masi želuca. Istovremeno, uticaj različitih formulacija obroka ispoljio je signifikantnan efekat (P<0.05) samo kod hibrida Cobb 500, između C i E-II grupe i to na telesnu masu pilića i masu jetre.

Ključne reči: pilići, enzim proteaza, osnovni delovi trupa, jestivi prateći proizvodi klanja

Acknowledgements

This study is part of Project No. 31033 titled “Sustainable Conventional and Revitalised Traditional Production of Value-Added Poultry Meat and Eggs“ financially supported by the Ministry of Science and Technological Development of the Republic of Serbia.

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