

EFFECT OF DIETARY PROTEASE SUPPLEMENTATION AND SEX ON DRESSING PERCENTAGE AND BODY CONFORMATION IN BROILERS

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Abstract: This paper presents research results on the effect of protease on the dressing percentage of conventionally dressed carcass and body conformation in broiler chickens. Broiler diet was supplemented with 0.2% protease (group E-I) and 0.3% protease (group E-II), and protein content in the feed was reduced by 4% (E-I) and 6% (E-II) through a decrease in soybean meal content. Fast-growing Cobb 500 broilers were used for a 63-day fattening trial. Body conformation measurement included absolute carcass conformation measures (metatarsus length, keel length, breast depth, breast angle, thigh girth) and relative body conformation measures – conformation indices (body weight/metatarsus length, body weight/keel length, body weight/breast depth, body weight/thigh girth). Results showed a significant effect of sex on the dressing percentage of conventionally dressed carcass and all body conformation measures, whereas diet had a significant effect on the dressing percentage of conventionally dressed carcass and breast angle values.

Key words: broilers, protease, dressing percentage, body conformation

Introduction

The main goal of modern broiler production is to ensure maximum use of the genetic potential of broiler hybrids. An increased demand for breast, thigh and thigh meat has led to research on ways to increase the yield of primal cuts of broiler carcass through production i.e. fattening. Intensive selection over the last decades has focused on the traits: weight gain, final body weight, feed conversion ratio, vitality, feathering, body conformation, skin color and, to some extent, meat quality. The results of the selection and production work include increasing growth rate and increasing body weight, along with improvement in feed conversion ratio,

over a relatively short fattening period of 42 days. *Leeson (2007)* emphasized that modern broiler hybrids have a high growth rate and a good feed conversion ratio, but often suffer from metabolic diseases, leg problems and increased fat deposition. Changes in basic principles of chicken meat production in EU countries, primarily regarding the maintenance and improvement of farm animal welfare, environmental protection and food safety, have prompted intensive development of various natural (ecological, biological, organic, biodynamic etc.) food production programs (*Škrbić et al., 2011*), involving a prolonged fattening period, lower stocking densities per unit area, modifications in existing poultry feed formulations, use of biologically active ingredients in poultry diet (enzymes, antioxidants, organic acids).

For their normal growth and development, chickens require optimization of a large number of factors, both nutritional and ambient. The most important nutritional requirement for optimum animal performance is to provide appropriate dietary levels of proteins (*Bregendahl et al., 2002*) i.e. amino acids (*Wijten et al., 2004*). Young fattening poultry need relatively high amounts of protein in the diet for optimum growth. On a global scale, the majority of protein ingredients incorporated into animal feeds are obtained from vegetable proteins, with oilseed crops and legumes being the main sources. Vegetable proteins are inadequate for poultry, not only in terms of sufficiency - quantity, but also in terms of quality – amino acid balance. Moreover, the vegetable sources of protein vary both in crude protein concentration and in the amino acid composition of the protein (*Thorpe and Beal, 2001*).

More recently, a significant number of researchers have opted to focus on the effect of protease supplementation of broiler diets on production performance, nutrient digestibility and meat quality (*Maiorka et al. 2009; Fidelis et al. 2010; Angel et al. 2011; Frietas et al. 2011; Dosković et al. 2015*).

The objective of this study was to examine the effect of protease (Ronozyme ProAct) on the dressing percentage of conventionally dressed carcass and body conformation of broilers.

Materials and Methods

A total of 300 day-old Cobb 500 broilers were allocated to three groups i.e. boxes (4.1m x 2.6m), each containing 100 birds at a stocking density of 10 birds/m². The broilers were randomly grouped, giving a random ratio of male to female birds across groups. Chicks had free access to water and feed, and a 24-h photoschedule was applied. Ad libitum feeding was used. Optimal microclimate conditions were provided by ventilation system (through roof openings and using ventilation fans).

The experimental period was 63 days.

Dietary treatments

A three-stage feeding/fattening program was used, including starter (0-21 days), grower (22-42 days) and finisher (42-63 days).

One group of broilers was a control - C (fed a diet with a normal nutrient composition, in accordance with dietary requirements for individual fattening stages), and the other two groups were experimental groups i.e. E-I and E-II (receiving a diet with a 4% and 6% reduction in crude protein content, and with 0.2% and 0.3% protease supplementation, respectively).

Broiler feeds were in powdered form. Feed ingredients (used across fattening stages and test groups) and the chemical composition of feeds are presented in Table 1.

The enzyme protease commercially available as Ronozyme ProAct (DSM, The Netherlands) was used. Ronozyme ProAct is a preparation of serine protease produced by a genetically modified strain of *Bacillus licheniformis*. It is produced in solid and liquid forms and is intended for use as a feed additive in chickens for fattening at a recommended dose of 200 mg kg⁻¹, within the category of zootechnical additives, under the functional group of digestibility enhancers.

Table 1. Ingredients and nutrient composition of experimental diets for broilers¹

Ingredient, %	Starter stage (1 to 21 d)			Grower stage (22 to 42 d)			Finisher stage (43 to 49 d)		
	C	E-1	E-2	C	E-1	E-2	C	E-1	E-2
Treatments	C	E-1	E-2	C	E-1	E-2	C	E-1	E-2
Maize	52.49	54.92	56.26	63.15	65.28	66.34	68.62	70.60	71.59
Soybean meal	22.24	19.79	18.44	13.00	10.85	9.78	9.10	7.10	6.10
Soybean groats	18.50	18.50	18.50	17.00	17.00	17.00	15.40	15.40	15.40
Feeding yeast	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
L-Lysine (78%)	0.10	0.10	0.10	0.20	0.20	0.20	0.23	0.23	0.23
DL-Methionine (99%)	0.22	0.22	0.22	0.30	0.30	0.30	0.30	0.30	0.30
Limestone	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Monocalcium phosphate	1.30	1.30	1.30	1.20	1.20	1.20	1.20	1.20	1.20
Salt	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Calcium formiate (30.5%)	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Captex T	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Premix	1	1	1	1	1	1	1	1	1
Protease	0.00	0.20	0.30	0.00	0.20	0.30	0.00	0.20	0.30
Calculated composition									
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
Total P, %	0.73	0.72	0.72	0.68	0.67	0.67	0.66	0.65	0.65
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
Methionine+cystine, %	0.92	0.90	0.89	0.91	0.89	0.88	0.86	0.84	0.83

¹ Treatments: C-control group, standard broiler diet, without protease; E-I- broilers fed a diet with a 4% reduction in crude protein level compared to control diet, and with 0.2% protease supplementation; E-II broilers fed a diet with a 6% reduction in crude protein level compared to control diet, and with 0.3% protease supplementation.

Data collection

At 63 days, 10 male and 10 female broilers were randomly selected from each group, tagged, weighed and slaughtered after a fasting period of 10 hours.

At slaughter, ready-to-grill carcass weight and abdominal fat weight were measured. Then, each carcass was dissected into primal cuts i.e. breast, drumsticks, thighs, wings, back, pelvis (according to the *Commission Regulation (EC) No. 543/2008*), and the following carcass conformation measures were taken (using the method of *Pavlovski and Mašić, 1983*): breast angle BA (degrees), metatarsus length ML (mm), keel length KL (mm), breast depth BD (mm) and thigh girth TG (mm). These measures indicated the body structure and development of certain i.e. major carcass parts of broilers. In order to eliminate the influence of body weight on these measures, their index values were determined (body weight/metatarsus length (g/mm) BW/ML, 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) with the exception of breast angle, which is a genetically determined trait and, as such, only slightly affected by body weight (*Škrbić et al. 2011*).

Statistical analysis

The data obtained in this study were subjected to conventional statistical methods.

The significance of differences for meat quality parameters (dressing percentages, body conformation measures) was tested by the mathematical model of a two-factor analysis of variance (2x3 design – 2 sexes-S and 3 feeding treatments-FT).

The significant differences determined by the analysis of variance and the results of F-exp values were evaluated using Tukey's test. Significance was accepted at $P < 0.05$.

The test parameters were examined by the analysis of variance (ANOVA) using the statistical software *Statistica for Windows Release 6.0 (1995)*.

Results and Discussion

The dressing percentage of conventionally dressed carcass and relative body conformation measures are given in Table 2.

The analysis of the data in Table 2. shows that all carcass quality parameters were significantly affected by sex, with females having a significantly higher dressing percentage for conventionally dressed carcass, but lower values of all body conformation measures ($P < 0.05$), except keel length in E-II broilers ($P > 0.05$), which was due primarily to higher body weight at slaughter. Similarly, some other authors (*Pavlovski et al. 2007; Hopić et al. 1996; Hopić et al. 2000; Blagojević et al. 2009*) have reported higher values for all absolute body conformation measures and better body conformation scores in male broilers

compared to females, regardless of age. The different diet formulations used for the experimental groups of broilers had a considerably lower effect on the carcass traits tested. Namely, significance was observed only when comparing the dressing percentage of conventionally dressed carcass (control males had a higher dressing percentage compared to E-I and E-II male broilers) and breast angle values (the highest breast angle was obtained in control males, with significance determined compared to E-II male broilers and also between control and E-I females). *Dosković et al. (2012)* found that different protein levels used in broiler diet with or without protease supplementation had no effect on the dressing percentage of conventionally dressed carcass, linear conformation measures and conformation indices in Cobb 500 broilers on day 49 of the fattening trial.

Table 2. Dressing percentage of conventionally dressed carcass and body conformation (absolute values) of broilers across experimental groups

Treatment			Yield "CP", %	ML mm	KL mm	BD mm	BA degrees	TG mm
Protease	Sex							
No	♂	\bar{x}	84.97 ^c	91.30 ^{ab}	130.20 ^{ab}	118.80 ^a	161.70 ^a	173.10 ^a
		Sd	0.81	2.75	1.55	4.08	5.64	6.84
	♀	\bar{x}	87.19 ^a	80.80 ^c	126.80 ^c	108.40 ^b	154.10 ^{bc}	158.40 ^b
		Sd	0.49	3.76	1.81	3.78	6.81	7.44
0.2%	♂	\bar{x}	84.94 ^c	93.60 ^a	130.60 ^a	116.40 ^a	159.20 ^{ab}	171.40 ^a
		Sd	0.51	2.37	1.07	6.67	7.15	5.29
	♀	\bar{x}	86.57 ^b	80.40 ^c	126.30 ^d	110.50 ^b	147.90 ^d	154.80 ^b
		Sd	0.70	2.76	3.59	4.50	7.61	7.27
0.3%	♂	\bar{x}	84.61 ^c	90.30 ^b	129.70 ^{ab}	116.30 ^a	154.50 ^b	167.10 ^a
		Sd	0.33	4.19	1.89	3.16	6.79	6.71
	♀	\bar{x}	86.47 ^b	81.00 ^c	128.30 ^{bc}	109.40 ^b	148.50 ^{cd}	159.40 ^b
		Sd	0.78	2.36	2.06	1.78	6.62	7.46
p-value								
Source of variation								
Protease			0.030	0.377	0.670	0.841	0.014	0.398
Sex			0.000	0.000	0.000	0.000	0.000	0.000
Protease x sex			0.333	0.137	0.100	0.224	0.454	0.108

CP- "conventional dressing", ML-metatarsus length, KL-keel length, BD-breast depth, BA-breast angle, TG-thigh girth

^{a-d} Means within columns with different superscripts differ significantly (P<0.05)

Index values of body conformation measures are presented in Table 3.

All body conformation indices (body weight/metatarsus length - BW/ML, body weight/keel length - BW/KL, body weight/breast depth - BW/BD and body weight/thigh girth - BW/TG) showed significant differences (P<0.05) when the effect of sex was considered, whereas no effect of diet (P>0.05) was observed.

Male broilers had higher relative body conformation scores compared to female birds, which was in agreement with the results of *Dosković et al. (2012)* in Cobb 500 broilers at 49 days of age, whereas *Blagojević (2011)* found that sex had a significant effect on BW/ML index in Master Gris broilers.

Table 3. Index values of body conformation measures in broilers across experimental groups

Treatment			BW/ML	BW/KL	BW/BD	BW/TG
Protease	Sex		g/mm	g/mm	g/mm	g/mm
No	♂	\bar{x}	48.50 ^a	33.99 ^a	37.28 ^a	25.59 ^a
		Sd	2.61	1.74	1.96	1.45
	♀	\bar{x}	44.33 ^b	28.19 ^b	32.94 ^b	22.54 ^b
		Sd	4.20	2.30	1.94	1.06
0.2%	♂	\bar{x}	46.94 ^a	33.62 ^a	37.73 ^a	25.64 ^a
		Sd	3.54	2.37	1.69	1.93
	♀	\bar{x}	44.57 ^b	28.35 ^b	32.40 ^b	23.15 ^b
		Sd	3.21	1.70	1.57	1.43
0.3%	♂	\bar{x}	47.21 ^a	32.78 ^a	36.56 ^a	25.51 ^a
		Sd	3.66	1.47	1.62	2.06
	♀	\bar{x}	43.63 ^b	27.53 ^b	32.28 ^b	22.17 ^b
		Sd	2.52	1.51	1.56	0.99
p-value						
Source of variation						
Protease			0.635	0.236	0.381	0.527
Sex			0.000	0.000	0.000	0.000
Protease x sex			0.687	0.870	0.559	0.680

BW – body weight at slaughter, ML – metatarsus length, KL – keel length, BD – breast depth, TG – thigh girth

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

Conclusion

The results suggest that Cobb 500 male broilers at slaughter on day 63 of the fattening trial had a significantly lower dressing percentage of conventionally dressed carcass compared to female broilers, and higher values of all linear body conformation measures ($P < 0.05$), except keel length (group E-II). Moreover, all relative body conformation measures – conformation indices were significantly affected by broiler sex ($P < 0.05$). The effect of reduced crude protein levels in broiler diets (a 4% and 6% reduction compared to protein content in control diet) supplemented with protease (0.2% and 0.3% protease, respectively) exhibited significant differences when comparing the dressing percentages of conventionally dressed carcasses (control males had a higher dressing percentage than E-I and E-II male broilers) and breast angle values (between control and E-II males, and

between control and E-I females). Diet had no effect on the other absolute body conformation measures and conformation indices.

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Uticaj proteaze dodate u hranu i pola na randman i konformaciju trupova tovnih pilića

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Rezime

U radu su prikazani rezultati ispitivanja enzima proteaze na randman klasično obrađenog trupa i konformaciju trupova pilića u tovu. Enzim proteaza dodat je u hranu za piliće u tovu u koncentraciji 0,2% (O-I grupa), odnosno 0,3% (O-II grupa), uz istovremeno smanjivanje sadržaja ukupnih proteina u smešama za 4% (O-I grupa), odnosno 6% (O-II grupa), preko smanjenog učešća sojine sačme. U ogledu je korišćen brzorastući hibrid Cobb 500, a tov pilića trajao je 63 dana. Za ocenu konformacije trupova utvrđene su apsolutne mere konformacije trupa (dužina piska, dužina kobilice, dubina grudi, grudni ugao, obim bataka) i relativne mere konformacije trupova – indeksi mera konformacije (telesna masa/dužina piska, telesna masa/dužina kobilice, telesna masa/dubina grudi, telesna masa/obim bataka). Rezultati istraživanja su pokazali da je pol pilića imao značajan uticaj na randman klasično obrađenog trupa i na sve mere konformacije trupova, a da je ishrana pilića različitim formulacijama obroka imala signifikantan efekat na randman klasično obrađenog trupa i vrednost grudnog ugla pilića.

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