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EFFECT OF PROTEASE ON MEAT YIELD OF BROILERS

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Abstract: This study reports the effect of protease and reduced crude protein content on carcass weight and dressing percentage in fast-growing Cobb 500 broilers. The length of fattening was 49 days. E-I and E-II experimental broilers were fed complete feeds containing 0.2 and 0.3% (Ronozyme Pro Act) protease supplementation and crude protein levels reduced by 4% and 6%, respectively, compared to control broilers (C). Performance traits were evaluated. At the end of the fattening trial on day 49, 10 male and 10 female birds were randomly sacrificed from each experimental group to determine body weight, conventionally dressed, ready-to-roast and ready-to-grill carcass weights, and abdominal fat weight. The results suggest no significant effect of dietary treatments on carcass weight, dressing percentage, weight and abdominal fat content. Significant differences were observed in carcass weight and carcass yield between female and male broilers, whereas broiler sex had no significant effect on abdominal fat percentage.

Keywords: broilers, protease, dressing percentage.

Introduction

Modern chicken meat production involves the use of fast-growing strains and diet formulations that allow them to express their maximum genetic potential. Major characteristics of modern broiler strains include fast growth rates, high breast and leg muscle weight, and relative inactivity or poor mobility *(Gous and Cherry, 2004)*. However, to boost profitability, the broiler industry is steadily pushing broilers beyond their optimum biological limits through reduced fattening periods, increased final body weights, changes in body conformation, higher breast percentage; the use of feed additives in broiler diets and the administration of different products for disease prevention and control.

Poultry meat quality traits are affected by a range of factors such as strain, rearing method, nutrition, biologically active substances, health, welfare and the environment, which have a significant impact on muscle metabolism and meat chemical composition. Maize-soya based broiler diets are used in modern poultry production, with problems regarding GMO contamination of organic feed leading to research on the potential substitution of soybean meal as a source of protein *(Meluzzi et al., 2009)*. Broiler nutrition issues offer a challenge to nutritionists, demanding continuous dietary modifications, primarily in terms of the increased use of biologically active substances (enzymes, antioxidants, organic acids, etc.). The use of dietary enzymes is nutritionally, economically and environmentally justified. Numerous studies have shown that enzyme supplementation of broiler diets has no adverse effect on body weight, feed intake, feed conversion, nutrient digestibility, meat quality and production costs. One of the most important nutritional requirements for optimum animal performance is to ensure an adequate dietary protein level *(Bregendahl et al., 2002; Wijtten et al., 2004)*, given the vast array of functions performed by proteins in living organisms. Moreover, some researchers have dealt with a potential reduction in dietary protein levels *(Rostagno et al., 2007; Horniakova and Abas, 2009)* to help reduce nitrogen excretion into the environment *(Aletor et al., 2000)* as well as feeding costs, in view of the fact that protein feeds as sources of protein entail great expenses.

The objective of this study was to determine the effect of reduced crude protein levels in protease-supplemented diets on broiler meat yield.

Material and Methods

A total of 300 day-old Cobb 500 broilers were allocated to three groups-boxes each containing 100 birds at a stocking density of 10 birds/m^2.

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.

A three-stage feeding-fattening program was used, including starter (0-21 days), grower (22-42 days) and finisher stages (42-49 days).

One group of broilers served as the control-C (fed normal nutrient levels, in accordance with broiler requirements during certain fattening stages), and the other two groups were experimental groups E-I and E-II (fed diets containing 4% and 6% lower crude protein levels and supplemented with 0.2% and 0.3% protease, 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.

A protease preparation commercially called Ronozyme ProAct (produced by DSM, The Netherlands) was used in the fattening trial. The product is intended for use as a feed additive in chickens for fattening at a recommended dose of 200 mg kg-1.

Table 1. Ingredients and nutrient composition of experimental diets for fattening chickens[1]

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
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 as compared to the control group, and 0.2% protease supplementation; E-II broilers fed a diet with a 6% reduction in crude protein level as compared to the control group, and 0.3% protease supplementation.

On day 49 of the fattening trial, 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, conventionally dressed, ready-to-roast and ready-to-grill carcass weights and abdominal fat weight were determined and used to calculate dressing percentage and pre-slaughter abdominal fat percentage.

The data were subjected to conventional statistical methods. The significance of differences was tested by a two-factor analysis of variance using a 3x2 design (3 feeding treatments and 2 sexes).

The significant differences determined by the analysis of variance and results of F-exp values were evaluated using Tukey's test. Significance was accepted at $P<0.05$. The test parameters were subjected to an analysis of variance using ANOVA, *Microsoft STATISTICA Ver. 5.0, StatSoft Inc. (1995)*.

Results and Discussion

Table 2. presents conventionally dressed, ready-to-roast and ready-to-grill carcass weights and abdominal fat weight in broilers.

Table 2. Dressed carcass yield and abdominal fat weight of broilers (in g)

Groups	Sex		Pre-slaughter body weight	Conventionally dressed carcass weight	Ready-to-roast carcass weight	Ready-to-grill carcass weight	Abd. fat weight
C (no protease)	♂	$\bar{x}$	3463.50	2986.78[a]	2807.19[a]	2581.70[a]	50.06
		Sd	104.48	100.74	94.43	88.24	13.62
	♀	$\bar{x}$	2898.50	2520.07[b]	2386.67[b]	2176.15[b]	49.43
		Sd	160.68	156.79	146.44	130.54	12.39
	♂+♀	$\bar{x}$	**3181.00**	**2753.42**	**2596.93**	**2378.92**	**49.74**
		Sd	**318.44**	**271.61**	**246.81**	**234.61**	**12.68**
E-I (0.2% protease)	♂	$\bar{x}$	3394.00	2916.37[a]	2738.01[a]	2501.72[a]	57.31
		Sd	133.35	125.25	120.28	123.71	18.17
	♀	$\bar{x}$	2877.50	2519.08[b]	2381.65[b]	2170.70[b]	49.89
		Sd	114.19	109.13	106.15	106.31	11.79
	♂+♀	$\bar{x}$	**3135.75**	**2717.72**	**2559.83**	**2336.21**	**53.60**
		Sd	**291.21**	**233.69**	**213.56**	**203.56**	**15.39**
E-II (0.3% protease)	♂	$\bar{x}$	3388.50	2909.46[a]	2729.95[a]	2510.34[a]	48.97
		Sd	205.25	179.10	167.95	161.24	11.20
	♀	$\bar{x}$	2816.50	2442.02[b]	2302.95[b]	2096.93[b]	48.37
		Sd	78.35	69.44	71.68	59.39	14.97
	♂+♀	$\bar{x}$	**3102.50**	**2675.74**	**2516.45**	**2303.63**	**48.67**
		Sd	**330.10**	**273.82**	**252.54**	**242.82**	**12.87**
p-value							
Source of variation							
Protease			0.210	0.170	0.123	0.131	0.503
Sex			0.001	0.001	0.001	0.001	0.425
Protease x sex			0.790	0.615	0.602	0.470	0.672

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

The data in Table 2. reveal similar carcass weights, regardless of dietary treatment; therefore, no significant effect (P>0.05) of diet on the carcass quality traits tested was observed. In addition, broilers had similar abdominal body weight, with no difference observed (P>0.05). Pre-slaughter body weight was lower in female birds than in males; hence, dressed carcass weight was significantly lower in females, compared to male broilers (P<0.05), whereas abdominal fat weight showed no significant differences between the sexes (P>0.05).

Given the above-mentioned results, dressed carcass yield was largely dependent on slaughter weight, with the average dressed carcass weights being higher in broilers having increased average slaughter weights.

Data on the dressing percentage of dressed carcass weights and pre-slaughter abdominal fat percentage, across test factors (dietary treatments, broiler sex), are given in Table 3.

Table 3. Dressing percentage and abdominal fat percentage (in %)

Groups	Sex		Dressing percentage for conventionally dressed carcass	Dressing percentage for ready-to-roast carcass	Dressing percentage for ready-to-grill carcass	% abd. fat
C (no protease)	♂	$\bar{x}$	86.23^{b}	81.05^{bc}	74.54^{abc}	1.44
		Sd	0.87	0.92	1.08	0.38
	♀	$\bar{x}$	86.92^{ab}	82.32^{a}	75.06^{ab}	1.70
		Sd	0.87	0.85	0.65	0.40
	♂+♀	$\bar{x}$	**86.57**	**81.68**	**74.80**	**1.57**
		Sd	**0.91**	**1.08**	**0.91**	**0.40**
E-I (0.2% protease)	♂	$\bar{x}$	85.92^{b}	80.66^{bc}	73.69^{c}	1.69
		Sd	0.65	0.85	1.6	0.56
	♀	$\bar{x}$	87.53^{a}	82.76^{a}	75.42^{a}	1.74
		Sd	0.63	0. 90	1.24	0.45
	♂+♀	$\bar{x}$	**86.73**	**81.71**	**74.55**	**1.72**
		Sd	**1.04**	**1.37**	**1.43**	**0.50**
E-II (0.3% protease)	♂	$\bar{x}$	85.86^{b}	80.56^{c}	74.07^{bc}	1.45
		Sd	0.59	0.72	0.86	0.34
	♀	$\bar{x}$	86.71^{ab}	81.76^{ab}	74.45^{abc}	1.71
		Sd	0.90	0.95	0.81	0.48
	♂+♀	$\bar{x}$	**86.28**	**81.16**	**74.26**	**1.58**
		Sd	**0.86**	**1.03**	**0.84**	**0.43**
p-value						
Source of variation						
Protease			0.131	0.186	0.227	0.504
Sex			0.001	0.001	0.001	0.110
Protease x sex			0.470	0.128	0.063	0.687

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

The dressing percentage of conventionally dressed carcass and ready-to-roast carcass was highest in E-I broilers (86.73% and 81.71%) and lowest in E-II broilers (86.28% and 81.16%, respectively). E-II was also found to have the lowest dressing percentage of ready-to-grill carcass (74.26%), which was the highest in control broilers (74.80%). Pre-slaughter abdominal fat percentage was 1.57-1.72%. As regards the effect of dietary treatments on dressing percentage, no significant effect of this factor on the percentage of differently dressed carcasses in liveweight was observed ($P>0.05$). In contrast, broiler sex was found to affect the dressing percentage of broilers, with E-I females exhibiting significantly higher values for conventionally dressed and ready-to-grill carcasses, compared to male birds ($P<0.05$). Moreover, the dressing percentage of ready-to-roast carcass was higher in female broilers than in males, with the significance observed in all three groups ($P<0.05$). Pre-slaughter abdominal fat percentage was not affected by either dietary treatment or broiler sex ($P>0.05$).

The comparison of the present results to those reported by other authors suggests that the values for the dressing percentage of both conventionally dressed and ready-to-roast carcass were somewhat higher than those obtained by *Nikolova et al. (2011)* in a 49-day fattening trial. Also, the dressing percentage of ready-to-grill carcass was somewhat higher than the values reported by *Café et al. (2002)*, *Si et al. (2004)*, *Abudabos (2010)*, *Bogosavljević-Bošković et al. (2011a)*, *Nikolova and Bogosavljević-Bošković (2011)*, *Petričević et al. (2011),* etc. Differences in dressing percentage values may be due to differences in the length of fattening stages, stocking density, …

Furthermore, dressed carcass yield and dressing percentage were not significantly affected by dietary treatments, which is in agreement with the results obtained by *Espino et al. (2000)*, *Osei and Oduro (2000)*, *Café et al. (2002)*, *Yadav and Sah (2005)*, *Abudabos (2010)* and *Frietas et al. (2011)*. Conversely, *Hajati et al. (2009)* reported an increase in dressing percentage due to the effect of enzymes. Broiler sex was found to have a significant effect on ready-to-grill carcass weight and no effect on dressing percentage (*Bogosavljević-Bošković et al., 2011a*). *Bogosavljević-Bošković et al. (2011b)* found a somewhat higher dressing percentage of conventionally dressed, ready-to-roast and ready-to-grill carcasses in females than in males, with the effect of sex being significant only for the dressing percentage of ready-to-roast carcass ($P<0.05$).

Pre-slaughter abdominal fat percentage was considerably lower compared to the results on Cobb 500 broilers at 49 days reported by *Café et al. (2002)*, *Si et al. (2004), Ahmadi and Karimov (2010)*, as well as to the findings of *Hajati et al. (2009)* for broilers at 44 days. The values for pre-slaughter abdominal fat percentage were not affected by dietary treatments, which complies with the results of *Hajati et al. (2009)* in their study on an enzyme complex containing arabinoxylanase and β-glucanase, *Abudabos (2010)* who used an enzyme complex (β-pentosanase, α-

amilase, glucanase and galactomanase), *Frietas et al. (2011)* who studied the effect of protease. In contrast, *Café et al. (2002)* found a significantly higher abdominal fat content in broilers fed diets supplemented with an enzyme complex containing xylanase, protease and amylase.

Conclusion

The results obtained suggest that the test carcass quality parameters were much more affected by broiler sex than by dietary treatments; moreover, the reduction in crude protein level in broiler feeds supplemented with 0.2 and 0.3% protease had no effect on dressed carcass weight, dressing percentage of conventionally dressed, ready-to-roast and ready-to-grill carcasses, and weight and pre-slaughter percentage of abdominal fat. Compared to female broilers, male birds had significantly higher dressed carcass weights and significantly lower dressing percentages. No significant effect of broiler sex on abdominal fat weight and percentage was observed.

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Uticaj proteaze na prinos mesa tovnih pilića

V. Dosković, Snežana Bogosavljević-Bošković, Z. Pavlovski, B. Milošević, Zdenka Škrbić, S.Rakonjac, V. Petričević

Rezime

U radu je analiziran efekat enzima proteaze, uz snižen nivo sirovih proteina na masu i udeo različito obrađenih trupova pilića brzorastućeg hibrida-Cobb 500. Tov pilića trajao je 49 dana. Ogledne grupe pilića E-I i E-II hranjene su potpunim smešama za tov pilića koje su imale za 4, odnosno za 6% manje sirovih proteina u odnosu na kontrolnu grupu (C), uz dodatak 0,2, odnosno 0,3% enzima proteaze (Ronozyme Pro Act) u hranu. U toku ogleda praćene su proizvodne osobine. Na kraju ogleda 49.dana, slučajnim izborom, odabrano je iz svake ogledne grupe po 10 muških i ženskih grla za klanje, izmerena njihova telesna masa, a na liniji klanja i masa klasično-obrađenog trupa, trupa „spremno za pečenje“, trupa „spremno za roštilj“ i udeo abdominalne masti.

Na osnovu rezultata istraživanja zaključeno je da nije bilo signifikantnog uticaja različitih formulacija hrane na masu i randman trupova i masu i udeo abdominalne masti. Istovremeno, između kokica i petlića pojavile su se značajne razlike u masi i prinosu trupova pilića, dok nije bilo razlika u sadržaju abdominalne masti pod uticajem pola pilića.

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