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CARCASS CHARACTERISTICS OF BROILERS FED ENZYME COMPLEX

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Abstract: Enzyme supplementation in diets based on corn and soybean meal can improve the productive performance of broilers. Thus, we aimed to evaluate the effect of the inclusion of different levels of an enzyme complex consisting of phytase, protease, xylanase, β-glucanase, cellulase, amylase, and pectinase, for diets based on corn and soybean meal, on the parameters of carcass yield and meat quality of broilers. Six hundred broiler chicks were used, and the animals were females with one day of age, from the Cobb 500 strain, and distributed in a completely randomized design, with five levels of inclusion of the enzyme complex (0, 100, 200, 300 and 400), and six repetitions, with twenty animals each. The carcass yield and meat quality were evaluated at 35 and 42 days of age. We evaluated the characteristics of weight loss by cooking (WLC), shear force (SF), water holding capacity (WHC), pH, lightness (L*) and color (a* and b*). The parameters of performance, carcass yield and carcass parts, and meat quality were not affected by the enzyme supplementation of diets fed to broiler chickens ($P > 0.05$), except for the performance characteristics of the breast and the wings at 42 days of age ($P < 0.05$).

Key-words: poultry, enzymes, meat quality, carcass yield.

Introduction

Broiler rations in Brazil are, almost entirely, formulated from two basic ingredients: corn, which is an excellent energy source, and soybean meal, which contributes with high-quality proteins and with great amino acid availability (*Opalinski et al.; 2006*). However, it is known that the nutrients originated from these foods are not properly absorbed, mainly because of the presence of anti-nutritional factors, such as NAPs (non-amylaceous polysaccharides) and phytic

acid. Therefore, mechanisms to enhance the performance of foods given to animals were made necessary. Aiming to increase the efficiency of rations, the usage of exogenous enzymes in the feeding of broilers is gaining more space and has become a great alternative, since it enhances food digestibility, minimizing the anti-nutritional effects and promoting the productivity indices (*Hooge et al.; 2010*). The use of enzyme complexes is effective, since the wide range of enzymes present in this type of product allows for greater action in different types of substrates and, or, foods utilized in the process of ration fabrication.

Factors that influence meat quality can mostly be controlled at various stages of setting up the chicken or during slaughter and processing. The carcass yield is closely linked to adequate food and nutrition of broilers. After all, animals with adequate supply of nutrients will deposit effectively muscle. The main meat quality measurement parameters are: pH, color, water-holding capacity and weight loss to cooking (*Mendes et al., 2003*). The final pH measured 24 hours post-mortem, it is decisive for quality meat, because it is directly related proteins and meat pigments. Thus, stabilization of the pH value influences the characteristics color, water-holding capacity, cooking weight loss, juiciness and softness (*Qiao et al., 2001*).

In light of this, this study aimed at evaluating the carcass yield and the carcass parts, and the quality of the meat for broilers that were submitted to the diets based on corn and soybean meal with different levels of the SSF (solid state fermentation) enzyme complex.

Materials and Methods

This experiment was conducted in the facilities of the broiler sector of the Animal Science Department of University Federal of Vales of Jequitinhonha and Mucuri (UFVJM). Six hundred broiler chicks were used, and the animals were females with one day of age, from the Cobb 500 strain. This design was completely randomized with five treatments and six replications with 20 broilers each. The treatments consisted of five inclusion level of enzyme complex (0, 100, 200, 300, 400 g/ton). The enzyme complex SSF is composed of seven distinct enzymes: phytase, protease, xylanase, β-glucanase, cellulase, amylase, and pectinase.

The diets were formulated according to the adaptations by *Rostagno et al. (2011)*. The percent composition and the calculated levels of nutrients for the control diets for the initial stage (1 to 21 days of age), the growing stage (22 to 35 days of age) and the final stage (36 to 42 days of age) are presented on Table 1.

Table 1.Percentage composition and calculated nutrient levels of experimental diets.

Ingredients	Initial	Growth	Final
Corn	61.110	64.026	66.659
Soybean mean	33.413	30.255	26.619
Soybean oil	1.169	2.636	3.169
Limestone	0.925	0.816	0.000
Dicalcium phosphate	1.490	1.156	2.040
Common salt	0.456	0.443	0.418
L-lysine HCl 99%	0.245	0.136	0.104
DL-methionine 99%	0.289	0.209	0.159
L-threonine 98%	0.073	0.005	0.000
Mineral supplement[1]	0.050	0.050	0.050
Vitamin supplement[2]	0.100	0.100	0.100
Salinomycin 12%	0.055	0.055	0.055
Antioxidant BHT	0.010	0.010	0.010
Choline chloride 60%	0.100	0.100	0.100
Enzyme complex[3]	0.000	0.000	0.000
Inert[4]	0.040	0.040	0.040
Total	100.0	100.0	100.0
Metabolizable energy, MJ/kg	12,56	12,98	13,19
Crude protein (%)	20.400	19.000	17.500
Calcium (%)	0.809	0.683	0.759
Available phosphorus (%)	0.386	0.319	0.264
Digestible lysine (%)	1.165	1.005	0.892
Digestible methionine (%)	0.559	0.467	0.403
Methionine+digestiblecystine (%)	0.839	0.733	0.651
Sodium (%)	0.200	0.195	0.185

[1]Safety levels per kg of the product (Min): Folic acid 750 mg, Pantothenic acid 12g, B.H.T. 1.000 mg, Biotin 25 mg, Niacin 35g, Vitamin A 8.000.000 UI, Vitamin B1 1.500mg, Vitamin B12 12.000 mg, Vitamin B2 5.000 mg, Vitamin B6 2.800 mg, Vitamin D3 2.000.000 UI, Vitamin E 15.000 UI, Vitamin K3 1.800 mg.

[2]Safety levels per kg of the product (Min): Copper 20 g, Iron 96 g, Iodine 1.400 mg, Manganese 156 g, Selenium 360 mg, Zync 110g.

[3]Allzyme SSF – Alltech Ind.: minimul levels of enzyme activity: phytase 300 UF/g; protease 700 UI/g; xylanase 100 UI/g; β-glucanase 200 UI/g; cellulase 40 UI/g; α amylase 30 UI/g and pectinase 4000 UI/g.
[4]Caulim.

At 35 and at 42 days of age, two animals of each repetition were selected by the average weight of the group (± 5%) for evaluation of the performance for the carcass, breast, leg quarter, wing and abdominal fat. After eight hours of fasting, the animals were packed in boxes and transported to a room lit by artificial blue light. All the slaughtering procedures were approved by the Ethic Committee of UFVJM, process nº 034/12.

After the evisceration, the carcass yield was obtained in relation to the body weight: % CY = (carcass weight x 100/body weight). The performance for the breast, the leg quarter and the wing were calculated in function of the carcass weight: % BP = (weight of the part x 100/carcass weight). The performance for the abdominal fat was calculated in function of the body weight of the animals. For the evaluation of meat quality, cooled, skinless, boneless breast meat. The pH was standardized at room temperature, 25º C, by means of a pH meter (Tecnopon mPA210) attached to the penetration electrode (Hanna Hl 8314) and introduced directly in the muscle "Pectoralis major". The method described by *Hamm (1960)* was utilized in order to determine the water retention capacity (WRC).

Weight loss by cooking was achieved with the methodology proposed by *Cason et al. (1997)*. The analysis of the shear force was made by a StableMicroSystems TAXT 2 PLUS texturometer attached to a blade set V Wanner Bratzler probe. It was considered the force peak of the analysis, therefore determining necessary force for the cuts. Color analysis was conducted with a raw meat sample, with longitudinal cuts in the breast portion made by a Minolta CR 400 colorimeter, with a CIELAB system (L*, a* and b*), where L* = luminosity, a* = red content and b* = yellow content.

The statistical analysis of the data was carried out by the GLM procedure of the SAS program (SAS, 2002), the data were submitted to a regression analysis, with the significance rate at 5%.

Results and Discussion

The inclusion of the SSF enzyme complex did not influence ($P > 0.05$) the parameters of carcass yield of broilers with 35 days of age ($P < 0.05$) (Table 2).

Table 2. The parameters of carcass yield of broilers with 35 days of age

Variables	Levels of EC addition (g/ton) – 35 days					CV (%)	P value
	0	100	200	300	400		
CY	73.54	74.32	74.17	74.04	73.60	1.39	0.9344
BP	38.61	38.07	38.12	38.71	38.67	3.70	0.6733
WP	10.47	10.34	10.18	10.32	10.43	4.49	0.8695
LQP	27.04	26.57	26.60	26.88	26.53	2.49	0.4168
FP	1.88	1.62	1.41	1.70	1.67	27.33	0.5648

CV = coefficient of variation (%); P value = significance rate of the regression analysis.

The inclusion of the SSF enzyme complex did not influence ($P > 0.05$) the parameters of carcass yield of broilers with 42 days of age, but did have an influence on breast and wing performance ($P < 0.05$) (Table 3).

Table 3. Average values for carcass yield (CY), breast performance (BP), wing performance (WP), leg quarter performance (LQP) and fat performance (FP), of broilers of 42 days of age, submitted to diets containing different levels of enzyme complex (EC).

Variables	Levels of EC addition (g/ton) – 42 days					CV (%)	P value
	0	100	200	300	400		
CY	74.06	73.25	73.21	72.70	75.36	2.53	0.2838
BP	40.05	40.11	40.41	39.73	38.24	3.83	0.0417
WP	9.73	10.44	10.22	10.84	10.43	5.28	0.0228
LQP	26.46	26.74	26.85	27.21	27.50	6.75	0.3225
FP	1.76	1.67	1.64	1.98	1.58	26.60	0.8591

CV = coefficient of variation (%); P value = significance rate of the regression analysis.

Broiler meat, according to *Petracci and Baéza (2011)*, has the following as its main intrinsic attributes: appearance, texture, succulence, flavor, and functionality; coloring is the most important factor that affects the choice of

consumers. They also state that the pH is closely related to all the factors that affect meat quality, although this effect is complex. This complexity is due to the many reaction associated with the heme factor, which depends on pH (*Werner et al. 2009*). However, the inclusion of the SSF enzyme complex did not influence (P > 0.05) the parameters of meat quality or meat color, carcass yield of broilers with 42 days of age (Table 4).

Table 4. Average values for weight loss by cooking (WLC), shear force (SF), water retention capacity (WRC), hydrogenionic potential (pH), luminosity (L*), red content (a*) and yellow content (b*) of the breast of broilers with 42 days of age, submitted to diets containing different levels of enzyme complex (EC).

Variables	Levels of EC addition (g/ton) – 42 days					CV (%)	P value
	0	100	200	300	400		
WLC (%)	30.54	26.40	29.54	31.48	26.03	16.79	0.5510
SF (kgf.cm^{-2})	3.16	3.07	3.33	2.45	3.20	18.61	0.4969
WRC (%)	44.98	47.13	44.2	48.01	46.71	10.51	0.4850
pH	5.72	5.67	5.68	5.69	5.71	0.93	0.8317
L*	49.79	49.37	50.40	49.6	48.22	5.23	0.3751
a*	3.16	3.07	3.33	2.45	3.20	21.78	0.3226
b*	7.66	6.72	7.67	7.22	7.82	15.10	0.5782

CV = coefficient of variation (%); P value = significance rate of the regression analysis.

Cardoso et al. (2011) also did not verify any differences (P > 0.05) on carcass yield for broilers with 42 days of age. Regarding abdominal fat, *Souza et al. (2008)* observed an increase in the carcass of broilers at 42 days of age. *Kessler et al. (2000)*, state that the most efficient way to avoid fat excess in the carcass is the approximation between energy and protein. This fact can be explained by the increase in food digestibility to the level recommended for the addition of the complex, which overestimates the energy values of the ration. Thus, with the energy excess, there is the possibility of greater accumulation of abdominal fat, a fact that was not identified within this study.

This study verified a significant effect ($P < 0.05$) for breast performance and wing performance at 42 days for broilers fed with diets supplemented with SSF EC. The equation for breast performance was: $BP = 40.355 – 4.057EC$ ($r^2 = 0.15$), evincing the lack of concrete explanation of the effect of the inclusion of SSF EC on breast performance. Similar results were found by *Soto and Salanova et al. (1996)*, who verified an effect ($P < 0.05$) of enzyme supplementation in diets based on corn and soybean meal on the augmentation of the breast muscle in broilers with 42 days of age. The equation estimated from the significance of the regression regarding wing performance was: $WP = 9.953 + 1.729EC$ ($r^2 = 0.18$). It is possible to observe that a small variation on wing performance can be explained by the supplementation with SSF EC. This variance may have occurred due to an error inherent to the cutting that was carried out. It was executed by the collaborators of the activity, who may not have observed the necessary standardization and accuracy.

The greatest percentage increase, an average of 2.15% in relation to the other treatments, of the breast, with the enzyme levels recommended by the manufacturer (200 g/ton), may have occurred due to the fact that this level provides a better digestibility of the ingredients and, therefore, increases the amount of nutrients available for breast growth, since this cutting represents about 40% of the total carcass yield. For every other level over the recommended value for EC, this response may have not existed due to the lack of substrate available after the addition of an amount of enzymes greater than the recommended number without considering the nutritional energy matrix and, or, the diet proteins. It may also be due to the low fiber content present in low viscosity diets (*Soto and Salanova et al., 1996*). Therefore, regarding the rations with enzyme supplementation in the "on top" form, with supplementation of enzyme levels without the reduction of the total metabolizable energy, it is verified that the enzyme does not produce any beneficial effects above the recommended level, which happens due to the quality of the foods used in the formulation and to the meeting of the nutritional demands of the animals.

According to *Werner et al., (2009)*, the addition of enzymes does not affect quality parameters of the meat; they are interconnected with color and pH, which are mainly hampered by the loss of exudate and temperature pitches. *Zakaria et al., (2010)*, while working with diets based on corn and soybean meal supplemented with the SSF enzyme complex, also did not observe any effects ($P > 0.05$) regarding the parameters pH, WLC, WRC, color and luminosity for broilers at 42 days of age supplemented with EC (xylanase, protease and amylase).

Conclusion

The inclusion of the SSF enzyme complex in diets based on corn and soybean meal for broilers in the levels recommended by the manufacturer, 200 g/ton, enhanced the efficiency of the breast and the wing at 42 days and did not significantly influence the carcass yield and the quality of the meat.

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Osobine trupa brojlera hranjenih enzimskim kompleksom

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Rezime

Dodavanje enzima obrocima koji se zasnivaju na kukuruzu i sojinoj sačmi može poboljšati proizvodne performanse brojlera. Stoga, naš cilj je bio da se proceni efekat uključivanja različitih nivoa kompleksa enzima koji se sastoji od fitaze, proteaza, ksilanaza, β-glukanaze, celulaze, amilaze i pektinaze za obroke na bazi kukuruza i sojine sačme, na parametre prinosa trupova i kvalitet mesa brojlera. Šest stotina brojlerski pilića je korišćeno u ogledu, ženskog pola u uzrastu od jednog dana, hibrida Cobb 500, distribuirano u potpuno slučajnom dizajnu, sa pet nivoa uključivanja kompleksa enzima (0, 100, 200, 300 i 400), i šest ponavljanja, sa dvadeset životinja u svakoj. Prinos trupa i kvalitet mesa su procenjeni na 35 i 42 dana starosti. Ispitivali smo sledeće karakteristike: kalo kuvanja (WLC), silu kidanja (SF), sposobnost zadržavanja vode (WHC), pH vrednost, jačinu boje (L *) i boju (* b *). Parametri performansi, prinosa trupa i delova trupa i kvalitet mesa nisu bili pod uticajem enzimskih dopuna u ishrani brojlera (P> 0,05), osim osobine performansi grudi i krila u uzrastu od 42 dana (P <0,05).

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