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Research Article

Effect of Different Enzymatic Supplements in Diets of broilers Raised at High Stocking Density

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Abstract

Some insoluble components, such as non-starch polyssacharaides in corn and soybean meal, are not digested by broiler chickens and may interfere withthe absorption of other nutrients or affect the digestibility and the energy value of the diet. With the objective ofevaluating the inclusion of enzymatic complexes in diets based on corn and soybean meal on the productive performance of broilers raised at high stocking density, a pen trial using 1,456 one-day-old broiler chickens in a randomized design with 4 treatments and 7 replicates of 52 birds/pen (17 birds / m2) was conducted. The treatments were as follows: Control diet (commercial diet used by a commercial company); Control diet + enzymatic complex (100 mg/kg of protease, amylase, and xylanase); Control diet + 1500 mg/kg of α-galactosidase; and Control diet + 500 mg/kg of protease. The means were compared by using Dunnett's test, while adopting the control treatment as the reference treatment. At 7 d of age, there was no difference among the treatments. However, at 21 and 35 d of age, supplementation with enzymatic complexes improved the performance of the birds when compared to the control treatment, regardless of the type of enzyme that was used. No differences for the carcass and cuts yields were observed. The inclusion of enzymes in the diets of broilers raised at high stocking density has beneficial effects on the productive performance and its use must be considered as an important tool to reduce costs and to improve the intestinal health in broiler flocks

INTRODUCTION

The reduction of feed costs is a constant concern within the poultry industry [1], and the use of exogenous enzymes in the diets of broilers is an important tool to reduce these costs. Even with highly digestible diets, such as those based on corn and soybean meal, the addition of enzymes may improve the dietary energy, and the gut viscosity may be decreased [2]. Another strategy to reduce costs is to increase the number of chickens in a defined space . Many of the companies generally use high stocking density as an alternative to obtain high production per square meter, but this management practice may create the conditions that are necessary for the proliferation of certain pathogens, mainly those linked with enteric diseases.

Different blends of enzymes can be used in the diets of broilers because it has been estimated that the combination of indigestible nutrients could lead to losses of 400 to 450 kcal of energy in a typical broiler feed [3]. However, according to [4], the benefits of including enzymes in broiler chicken nutrition include not only better performance and feed: gain ratio, but also reduced environmental problems.

Corn and soybean meal are the 2 major ingredients in commercial poultry diets around the world [1], and are considered to have low concentrations of anti nutritive factors such as non starch polysaccharides (NSP) and protease inhibitors. Regardless of this fact, due to its high inclusion in the diets, both ingredients may become important sources of these substances. Furthermore, the enzymes could improve the digestion and absorption of the majority of the nutrients prior to the establishment of an environment that is favorable to bacterial growth [5].

On the other hand, there is an increasing interest regarding the use of enzymes to modulate the intestinal microbiota, because the enzymes could improve the digestibility and the feed utilization by the host. Even though little information is available regarding this topic, it is known that enzymes enhance nutrient delivery to the host and provide substrate (fermentable oligosaccharides) for the microbiota [6], consequently improving the intestinal health.

Different blends of enzymes, with specificity to different substrates, may have beneficial effects in promoting the intestinal health of birds that are raised in poor environmental conditions. Therefore, the objective of the current research was to compare the effect of different enzyme combinations in the diets of broilers raised under high stocking density on productive performance and carcass yield.

MATERIAL AND METHODS

All of the procedures that were used in this experiment were approved by the institutional animal care and use committee of the Federal University of Parana, Palotina, PR, Brazil. One-day-old male Cobb 500 broiler chickens (1,456 birds) were used in the experiment. Chicks were weighed by pen and placed in 28 pens with 17birds/m^2 (52 birds/pen and 7 replicates/treatment), from 1 to 35 days, in a completely randomized design.

The nutritional program consisted of three diets: starter (1-7 days), grower (8-21 days), and finisher (22-35 days; Table 1). The diets were based on corn and soybean meal, and the feed and water were supplied *ad libitum* during the entire experimental period. The treatments were as follows: Control (commercial diet used by a commercial company); basal diet + 100 mg/kg of enzymatic complex (protease, amylase and xylanase) - PAX; basal diet + 1500 mg/kg of α-galactosidase - GAL; and basal diet + 500 mg/kg of protease - PRO. The enzyme levels were determined based on the producer recommendations. The broilers were fed with the experimental diets up to 35 days of age.

Body weight and feed intake were recorded at days 7, 21 and 35 of age. Body weight gain and feed conversion ratio were calculated from these data. All pens were checked daily for mortality. Treatment, date of death, and body weight of each dead chick was recorded. The body weight gain was calculated on the basis of those birds, available on Days 7, 21 and 35, respectively. For the determination of feed intake and feed conversion ratio, the day of death and the weight of the dead birds were included in the calculation. At 35 days, two birds per replicate (14 birds per treatment) were slaughtered to evaluate the carcass yield. The broilers were selected based on their mean weight, while considering a 2% variation.

Data were analyzed by ANOVA with procedures appropriate for a completely randomized design using the GLM procedure of SAS. The means for treatments that showed significant differences were compared using the Dunnett's test while adopting the control treatment as the reference treatment.

RESULTS AND DISCUSSION

GlossalThe performance results of the birds at 7, 21, and 35 days of age are shown in Table 2. No differences were observed among the treatments in the performance of the chickens at 7 days of age. A trend was observed (P=0.08) for the feed conversion ratio, in which the chickens that were supplemented with protease, amylase, and xylanase and the chickens supplemented only with galactosidase had a better feed conversion ratio when compared to the control treatment. Some authors suggest that the inclusion of enzymes during the initial phase of the chickens may improve the digestibility of the diet and the performance of the birds [7,8]; however, this effect was not observed in this study, regardless of the numerical improvement in the feed conversion ratio in the chickens that were fed with enzyme preparations.

[9] obtained similar results, in that the authors did not find differences in the performance of the birds that were supplemented with amylase or amylase and protease at 7 and 14 days of age. In addition, the authors observed a lower protein

Table 1: Nutritional composition of the feeds.

Ingredients, %	Starter	Grower	Finisher
Corn	58.03	63.14	64.74
Soybeanoil	2.7	3.3	3.8
Animal by-productmeal	3.7	3.1	2.7
Limestone	0.54	0.53	0.54
Soybeanmeal	33.4	28.5	26.9
Salt	0.31	0.35	0.330
Sodiumbicarbonate	0.15	0	0
DL-Met	0.358	0.321	0.309
L-Lys HCL	0.262	0.245	0.238
L-Thr	0.098	0.708	0.072
Choline chloride	0.097	0.081	0.069
Anticoccidial	0.055	0.055	0
Mineral-vitaminpremix[1]	0.3	0.3	0.3
Calculatedcomposition			
CP, %	21,85	19,68	18,87
Ca, %	0,946	0,856	0,807
Available P, %	0,475	0,431	0,405
ME (kcal/kg)	3,100	3,198	3,250
Digestible Lys, %	1,240	1,101	1,050
Digestible Met+Cys, %	0,930	0,848	0,819
Digestible Thr, %	0,805	0,715	0,683
Digestible Trp, %	0,222	0,197	0,189
Digestible Leu, %	1,650	1,526	1,481
Digestible Ile, %	0,845	0,755	0,723
Digestible Val, %	0,921	0,831	0,798
Digestible Arg, %	1,335	1,185	1,131
Choline, mg/kg	1.800	1.600	1.500
Na+K+Cl, MEQ/100g	229	189	181

[1]Initial vitamin mixture (content per kg diet): Vit. A 10,500 IU; Vit. D3 3,300 IU; Vit. E 16.50 mg; Vit. K3 2.40 mg; Vit. B1 3.00 mg; Vit. B2 7.50 mg; Vit. B 12 18.00 mg; Niacin 52.50 mg; Pantothenic acid 19.50 mg; folic acid 120 mg.
[2]Mineral mix (content per kg diet): iron 15.00 mg; copper 24.00 mg; iodine 3.60 mg; zinc 150.00 mg; manganese 210.00 mg; selenium 0.60 mg.

Table 2: Productive performance (body weight, body weight gain, feed intake, and feed conversion ratio) of the broilers at 7, 21 and 35 days of age supplemented with different enzymes preparations.

Treatments	BW, g	BWG, g	FI, g	FCR
	1-7 days			
Comercial control	182.6	136.7	161.1	1.179
PAX	182.9	137.4	155.5	1.132 *
GAL	185.1	139.6	157.9	1.132 *
PRO	184.5	138.4	157.4	1.137
CV (%)	2.14	2.94	3.52	3.42
P Value	NS	NS	NS	0.08
	1-21 days			
Comercial control	840.2	794.3	1165	1.466
PAX	863.5	820.9	1139	1.387 *
GAL	875.0 *	829.6 *	1116	1.345 *
PRO	883.8 *	836.5 *	1142	1.366 *
CV (%)	2.87	3.00	3.19	4.37
P Value	0.003	0.005	NS	0.0002
	1-35 days			
Comercial control	2204.6	2077.1	3288.4	1.583
PAX	2207.0	2095.4	3219.8	1.536 *
GAL	2207.4	2100.0	3188.8	1.518 *
PRO	2218.3	2102.4	3229.7	1.536 *
CV (%)	3.00	2.72	3.03	2.24
P Value	NS	NS	NS	0.0002

PAX: protease, amylase and xylanase; GAL: galactosidase; PRO: protease; CV: coefficient of variation; *Statistical differences between the treatment and the commercial control by Dunnett's test at 5% of probability.

digestibility in the chickens that were supplemented with enzymes, thereby suggesting an impairment in the secretion of endogenous enzymes, i.e., trypsin and chymotrypsin [10].In contrast to these findings, in a recent study conducted by [11], the authors observed that chickens that were supplemented with enzymes had higher pancreatic amylase and trypsin activity than the un supplemented birds.

GlossalOn the other hand, at 21 days of age, statistical differences were identified for all variables (P<0.01), with the exception of feed intake (P>0.05). It was observed that the body weight and the body weight gain were better when the birds were supplemented with galactosidase and protease when compared to the commercial control treatment. In addition, the feed conversion ratio was better in the birds that were fed with the enzymes in relation to the birds in the commercial control treatment. On the other hand, [11] did not observe differences in the performance of the broilers that were supplemented with enzymatic complexes from 1 to 21 days of age with diets based on corn and soybean meal.

GlossalThere are some conflicting results in the literature regarding the use of enzymes in broiler diets in which the differences that are observed in the various publications may be due to different ingredients that were used during the feed formulation. For example, [4] explained that the use of glycanases has become a practical solution for improving the nutritional value of diets based on barley, rye, and wheat, and perhaps it may explain why the results of using such enzymes are not as consistent in diets that are based on corn and soybean meal. Another factor that may interfere with the enzyme activity is the form of the diet, such as mash versus pelleted diets. Even though the pelleting process has positive effects on the nutritional value of the diets, in can decrease the exogenous enzyme activity [12,13].

GlossalThe beneficial effects that were observed in our study with the inclusion of enzymes in the diets may be due to the high stocking density that was used in the experiment. It was adopted as a mean of simulating the commercial broiler production, mainly because of the competition among the birds for space in the feeder and for the impairment in the air quality inside the poultry house. Under these conditions, the enzymes may increase the availability of the nutrients to the host and decrease excretion into the environment, thus improving the microbial quality of the litter, among other effects, which consequently decrease the disease susceptibility in the broiler flocks and improve the well-being and performance of the birds.

GlossalRegarding the performance results that were obtained at 35 days of age, i.e., the entire experimental period, the only difference that was observed was in the feed conversion ratio. All of the treatments that were supplemented with enzymes had better feed conversion ratio when compared to the commercial control treatment (P<0.01). The experimental period of 35 days was used because of the high stocking density that was adopted. For this reason, the precarious conditions that were observed within the pens were the determining factors when deciding to finish the trial at that age.

GlossalExogenous enzymes in broiler nutrition are extensively used around the world; however, the manner in which their benefits are brought about is still not well understood [5]. According to this author, there are several reasons the enzymes may be included in diets: to increase feed value of raw materials, to reduce the variation in nutrient quality of ingredients, and to reduce the incidence of wet litter, which is more frequently observed when broilers are fed diets that are rich in barley, rye, and wheat. On the other hand, the beneficial effect those enzymes can bring to the intestinal microbial colonization of the birds, due to the reduced amount of indigestible nutrients that are available to the microbiota at the final portions of the intestine, must be taken into account.

Table 3: Carcass yield (%) of the broilers at 35 days of age supplemented with different enzymes preparations.

Treatments	Carcass, %	Breast, %	Thigh, %	Abdominal Fat, %
Comercial control	77.01	35.07	26.7	2.25
PAX	77.52	34.67	26.6	2.38
GAL	77.10	33.98	27.3	2.61
PRO	77.04	34.67	27.7	2.68
CV (%)	1.47	4.66	3.49	20.6
P Value	NS	NS	NS	NS

PAX: protease, amylase and xylanase; GAL: galactosidase; PRO: protease; CV: coefficient of variation

Glossal Table 3 displays the results regarding the carcass yield. Statistical differences (P>0.05) were not observed between the commercial control treatment and the treatments that were supplemented with enzymes. These findings are in accordance with other studies that did not find any difference for the carcass yield (%) when broilers were fed with enzyme preparations [14,15].

CONCLUSION

GlossalFrom our findings, it is possible to conclude that the supplementation with enzymes may improve the performance of birds that are raised at high stocking density. It is therefore important to consider this management as an important tool to reduce costs and to improve the environmental conditions inside the broilers' house. Nevertheless, more studies with the objective of evaluating the effects of the use of enzymes on the intestinal health of the birds, mainly on the balance of the microbiota and on the gut-associated immune system, must be conducted.

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