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EFFECT OF PELLETIZATION ON DIETS CONTAINING AN ENZYMATIC COMPLEX FOR BROILER CHICKENS

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ABSTRACT

This study aimed to examine whether pelletization interferes in the dietary enzymatic activity, in which an enzymatic complex (EC) produced by solid state fermentation technology was used. A total of 216 Cobb male broilers (1 to 21 days of age) were allocated in batteries. A total of 6 replicates per treatment, and 6 broilers per treatment were used. Treatments consisted of T1- control mash diet, T2- control pellet diet, T3- overestimated mash diet + EC, T4- overestimated mash diet without addition of EC, T5- overestimated pellet diet + EC, and T6- overestimated pellet diet without addition of EC. All overestimated diets were reformulated to 75 kcal ME/kg, 0.1% Ca and P. Growth performance, drumstick and thigh were increased with the use of pellet diet. Meat color was not influenced by dietary treatments. Results indicated that the enzymatic complex was not affected by pelleting (75º C) the diets.

KEYWORDS: Bone strength, broiler, meat color, pellet, performance.

RESUMO

EFEITO DA PELETIZAÇÃO EM DIETAS CONTENDO COMPLEXO ENZIMÁTICO PARA FRANGOS DE CORTE

O trabalho teve como objetivo avaliar se a peletização interfere na atividade enzimática de dietas com um complexo enzimático (CE) produzido utilizando a tecnologia de fermentação no estado sólido. Alojaram-se 216 frangos de corte machos Cobb (1 a 21 dias de idade) em baterias, num total de seis repetições por tratamento e seis aves por tratamento. Os tratamentos consistiram em T1: dieta-controle farelada; T2: dieta-controle peletizada; T3: dieta superestimada com CE farelada; T4: dieta superestimada sem CE farelada; T5: dieta superestimada com CE peletizada; T6: dieta superestimada sem CE peletizada. Reformularam-se dietas com superestimação de 75 kcal EM/kg, 0.1% Ca e P. Observou-se que houve um aumento no ganho de peso, coxa e sobrecoxa com o uso de dieta peletizada. A coloração da carne não foi influenciada pelos tratamentos. Resultados indicaram que dietas com o complexo enzimático não foram afetadas pela peletização (75º C).

PALAVRAS-CHAVES: Cor da carne, desempenho, frango de corte, pellets, resistência óssea.

INTRODUCTION

Aviculture has experienced great advancements. Because of that, nutricionists search alternatives to make ration more effective and economic, considering it is the most expensive item in the process of broilers production. Nowadays, broilers raised for exportation can not be fed animal-origin products. Furthermore, the prices of corn and soybean are increasing due to ethanol and biodiesel. According to WYATT & BEDFORD (1998), it is possible to reformulate the diet to reduce its costs without jeopardizing the productive performance of the animals. In this sense, enzymes are very important because they reduce production costs and because some ingredients have an antinutritional effect (LECZNIESKI, 2006). Moreover, enzymes reduce significantly environmental pollution. For these reasons, the use of enzymes in the production of commercial diets for broilers is a viable option for producers, considering the positive responses of feed digestibility and broilers´performance, which directly affects the production efficience (ALBINO et al., 2007).

ZANELLA et al. (1998) demonstrated that the adition of a multienzymatic complex to broilers´s diets, formulated with corn and whole grain toasted and extruded soybean improved the digestibility of proteins and starch from the diets. TORRES et al. (2003) and COSTA et al. (2004) verified that poultry fed corn and soybean meal supplemented with enzymatic complex presented greater nutrients digestibility and better productive performance.

Most part of nutrients specifications are established from the grounded meal, but such specifications can be different for the pelleted meal. Furthermore, it is essencial to have a judicious control of what happens with the enzymes added to the ration. Continuous monitoring of industries and production lines must be carried out, considering industries are not only different from each other, but production lines of an industry can present various conditions, such as processing temperature, steam pressure, conditioning time, kind of equipmente, production capacity, etc. The composition of the ingredients in the diet may have an important impact on the quality of the pellets because different ingredients relate differently with steam, pressure and temperature of the pelletization process (KLEIN et al., 1996).

Besides enzymes used in non-ruminant´s diets having to resist to ration storage, low pH and the proteolytic enzymes of digestive tract, they also must resist to the production process and conserve considerable activity because factors such as conditioning time, temperature and steam pressure are critical for the stability of enzymes in the ration (FRANCESCH, 1996; LECZNIESKI, 2006). When enzymes are subimitted to high temperatures they may present denaturation, losing the benefits of their addition to the animals´ diet (SARTORI, 1999).

According to GRAHAM & INBORR (1991), citaded by BORGES (1997), the molecular structure of ezymes is very fragile, and hence, it may be denaturated by heat, alkalies, heavy metals and other oxidative agents. The heat of pelletization process may inactivate the enzymes permanently, and the ideal enzyme should be able to endure temperature within 70 and 90 oC, usually reached during the pelletization process.

ROSE & ARSCOTT (1960) concluded that during the pelletization process, sensible alterations in the starch structure of cereals occur, making it more sensible to the attack of enzymes responsible for digestion, what justifies the improvement of the results obtained by pelleted diets. Pelletization process of ration increases its productive energy rate by the reduction of ingestion time and of the time spent for feed prehension (REDDY et al., 1961). According to FLEMMING (2002), poultry that recieved pelleted ration spent 4% of the time in feed ingestion whereas the ones that recieved grounded ration spent 15%.

Considering all these aspects, the objective with this study was to evaluate whether the pelletization process interferes in the efficiency of the enzymes added to the diet, influencing the productive developement,

cuts yields, breast muscle color and bone resistance of broilers from one to 21 days of age.

MATERIAL AND METHODS

The experiment was carried out in the experimental poultry house of the Department of Zootechny of Universidade Federal de Pelotas (Federal University of Pelotas), DZ/UFPEL, during 21 days from December 20th 2005 to January 10th 2006. A total of 216 male Ross 1-day-old chicks were alloted in two sets of batteries with five stores each, divided into four partitions of 90 cm length x 40 cm width x 30 cm height. A resistance heating system was used and the connections were made 12 hours after the allotment and kept for 24 hours on the first days. After that, they were handled according to the room temperature in the poultry house, following the recommendations by the Ross lineage manual. Maximum and minimum temperatures and relative air humidity inside the experimental poultry house were monitored daily. Paper sheets and trays with the starter ration were placed on the wire netting floor and withdrawn at the end of three days. Water and ration supply was carried out by means of drinkers and food troughs connected to the batteries. A random block experimental design was used, with six treatments of six replications each and six broilers per experimental unit. The data were submitted to variance analysis and the means were compared by contrast at a 5% probablity level, by the statistical software SAS.

When the chicks arrived they were individually weighed and distributed into boxes. The mean body weight was ±46 g. The treatments consisted of T1– mash control diet; T2 – pelleted control diet; T3 – superestimated diet (75 kcal ME /kg, 0.1% Ca, 0.1% iP) with mash SSF; T4 – superestimated diet (75 kcal ME /kg, 0.1% Ca, 0.1% iP) without mash SSF; T5 – superestimated diet (75 kcal ME /kg, 0.1% Ca, 0.1%iP) with pelletd SSF; T6 – superestimated diet (75 kcal ME /kg, 0.1% Ca, 0.1%iP) without pelleted SSF.

To produce broilers from 1 to 21 days of age (Table 1), the feeding program comprised corn and mash soybean, and was reformulated to superestimate the metabolizable energy at 75 kcal ME/kg, inorganic phosphorus at 0.1% and calcium at 0.1%. The enzymatic complex (EC - Allzyme SSF, Altech Inc. produced by Alltech do Brasil Agroindustrial Ltda.) was added to the diet at the proportion of 200g per 1000kg, according to recommendations by the manufacturer.

The enzymatic complex used in this work was composed by the following enzymes: phytase, protease, xylanase, ß-glucanase, cellulase, amylase and pectinase. The complex was produced by means of fungal activity with solid state fermentation technology, which makes possible a greater digestibility of the vegetal ingredients of the diet

The experimental diets were prepared by conventional mixture process at EMBRAPA-CNPSA (Concórdia – Santa Catarina, Brazil) ration industry. Part of the ration was bagged to be used as mash, the other part was pelleted with 4.0mm (3/32) sieve. The internal temperature was 75ºC.

Ration intake (RI), weight gain (WG), feed conversion (FC), mortality rate (MR), productive efficiency rate (PER) ((viability x weight gain (kg) / intake x FC) x 100) were analyzed. At the end of 21 days, all the broilers were weighed, and one broiler with body weight of ± 10% of the repetition mean was withdrawn per experimental unit. The slaughter was carried out at the Experimental Slaughterhouse of Conjunto Agrotécnico Visconde da Graça, Universidade Federal de Pelotas, CAVG/UFPEL (Visconde da Graça Agrotechnical Facilities of Federal University of Pelotas). Breast, thigh and drumstick were separated for yield determination and for the assessment of ashes, bone resistance and breast muscle color.

Tibia and femur were withdrawn from the right thighs and drumsticks, then they were weighed and defatted for the calculation of ashes percentage. For the defatting, the bones were immersed in ether for 12 hours. After that, they remained at room conditions for volatization and then they were put in a hothouse at 105ºC for 24 hours for dry matter determination. Subsenquently, they were put in a muffle furnace at 600ºC for 12 hours for ashes determination. Left tibia and femur were used in natura for bone resistance analysis in a computerized press (Instron Universal Testing Machine - model 1130). The bones were horizontally placed on two holders and the pressure was applied at the center of the bones. The maximum force applied

to the bone before its rupture is considered the bone resistance to breaking.

As for color determination, the major breast muscle (Pectoralis major) of each broiler was identified, wrapped in plastic film and frozen at -18 oC. For the analysis, the samples were thawed at 4 oC for 24 hours. After this period, the readings were carried out by a Minolta® colorimeter (model CR-300), on a plastic white board. The calibration was performed on a white tile. The system L*a*b* (McLAREN, 1976) was used, in which L corresponds to luminosity, a to the red index (ranging from green to red), and b to the yellow index (ranging from yellow to blue). Three readings were performed in each breast muscle (Pectoralis major) at different areas (cranial, medial and caudal portions), and the result was expressed as the mean of these readings.

TABLE 1. Composition of the experimental diets consumed by 1-21-day-old broilres

Ingredients (%)	T1	T2	T3	T4	T5	T6
Corn	59,07	59,07	62,47	62,47	62,47	62,47
Soybean meal	34,70	34,70	33,70	33,70	33,70	33,70
Limestone	1,20	1,20	1,20	1,20	1,20	1,20
Common salt	0,43	0,43	0,43	0,43	0,43	0,43
Dicalcium phosphate	1,82	1,82	1,26	1,26	1,26	1,20
Soybean oil	2,28	2,28	0,42	0,42	0,42	0,42
Mineral and vitaminic supplement [1]	0,50	0,50	0,50	0,50	0,50	0,50
Kaolin	0,00	0,00	0,00	0,02	0,00	0,02
EC[2]	0,00	0,00	0,02	0,00	0,02	0,00
Total (kg)	100	100	100	100	100	100
Cost (kg)	0,67	0,67	0,64	0,64	0,64	0,63
Nutritional levels calculated						
ME (kcal/kg)	2950	2950	2950	2950	2950	2950
Crude protein (%)	21,88	21,88	21,88	21,88	21,88	21,88
Cálcium (%)	0,9	0,9	0,9	0,9	0,9	0,9
Available phosphorus (%)	0,45	0,45	0,45	0,45	0,45	0,45
Digetible methionine (%)	0,53	0,53	0,53	0,53	0,53	0,53
Total lysine (mg/kg)	1,15	1,15	1,15	1,15	1,15	1,15
Systhetic choline (mg/kg)	1280	1280	1280	1280	1280	1280
Linoleic acid (%)	3,31	3,31	3,31	3,31	3,31	3,31

[1]Levels of guarantee/kg of product: vit A, 2,000,000 UI; vit B12, 2,400 mcg; manganese, 20,000 mg; vit D, 400,000UI; niacin, 8,000 mg; zinc, 12,000 mg; vit E, 3,000 mg; folic acid, 215 mg; iron, 10,000 mg; vit K, 340 mg; pantothenic acid, 3,200 mg; copper, 1,995 mg; vit B1, 360 mg; biotin, 16 mg; iodine, 120 mg; vit B2, 1,200 mg; methionine, 360 g; seleniuum, 65 mg; vit B6, 500 mg; choline, 100 g.
[2]Allzyme SSF = CE = 200 g/1000 kg = 20 g/100 kg = 0,2 .

RESULTS AND DISCUSSION

The data about the performance of broilers fed mash or pelleted diets, with or without enzymes, for 21 days, are shown in Table 2. The treatments had no significant effect on RI, MR, and PER. However, the treatments had an effect ($P<0.01$) on WG and FC. Such results disagree from the ones presented by GARCIA (1997), who verified RI in broilers when mash and pelleted corn-soybean diets were supplemented with the enzymes amylase, xylanase and protease.

Broilers fed pelleted diet presented higher WG

and better FC, when compared to the ones fed mash diet, despite the presence or not of the EC. This fact is probably due to the lesser ration waste and the higher nutrients concentration resulting from the pelletization process, whereas, depending on the granulometry of the mash diet, broilers select the biggest particles, what causes nutritional imbalance and, hence, worsens the performance. Nevertheless, HAMILTON and PROUDFOOT (1995) compared different granulometries in mash diets and observed that body weight increased along with diet granulometry. BUSTANY (1996) verified that the WG of chicks fed pelleted diet was 7.8% higher than the WG of chicks fed mash diet, and concluded that chicks fed mash diets were not able to adjust the consumption considering the low nutrient concentration in the ingredient particles.

LEITE (2006) compared a mash diet with two pelleted diets. The diets were formulated comprising EC (Allzyme® Vegpro) or not. Minerals and vitamins were added to the pelleted diets before and after pelletization. The author observed that the WG improved 3.31% when the mash diet supplemented with enzymes was used. As for pelleted diets with enzymes, vitamins and minerals added before the pelletization, there was a 1.78% WG improvement compared with non-supplemented diets.

In spite of the addition or not of the EC, broilers fed pelleted diets (control diet, superestimated pelleted diet with EC, superestimated pelleted diet without EC) presented better FC ($P<0.05$) than the ones fed mash diets, indicating that pelletization improves digestibility and nutrient absorption.

TABLE 2. Means of the performance variables of broilers fed mash or pelleted diets with or without enzymes, during 21 days: ration intake (RI, g), weight gain (WG, g), feed conversion (FC), mortality rate (MR%), and productive efficiency rate (PER)

Tratamentos	RI	WG	FC	MR	PER
T1 (mash control diet)	1121,66	764,90	1,46	0,00	263,16
T2 (pelleted control diet)	1065,18	817,96	1,30	4,17	302,00
T3 (mash diet reformulated with EC)	1115,46	751,43	1,48	0,00	255,50
T4 (mash diet reformulated without EC)	1092,53	753,15	1,45	0,00	262,16
T5 (pelleted diet reformulated with EC)	1133,88	841,31	1,34	16,66	269,66
T6 (pelleted diet reformulated without EC)	1139,55	842,75	1,35	8,33	288,83
CV %	7,3923	5,532	6,799	369,6	23,763
Simple Contrast					
T1 *vs* T2	ns	0,0453	0,0063	ns	ns
T1 *vs* T5	ns	0,0054	0,0423	ns	ns
T1 *vs* T6	ns	0,0045	0,0481	ns	ns
T2 *vs* T3	ns	0,0140	0,0023	ns	ns
T2 *vs* T4	ns	0,0163	0,0122	ns	ns
T3 *vs* T5	ns	0,0014	0,0175	ns	ns
T3 *vs* T6	ns	0,0011	0,0201	ns	ns
T4 *vs* T5	ns	0,0016	ns	ns	ns
T4 *vs* T6	ns	0,0013	ns	ns	ns

EC – enzymatic complex, ns= non significant ($P> 0.05$), CV= coefficient of variation.

Significant effect of treatments on preslaughter body weight (P=0.0003) and on thigh and drumstick yield (P=0.0470) could be observed at 21 days of age (Table 3). Broilers fed pelleted diet presented higher weight than the ones fed mash diet, with or without EC. This fact was confirmed by contrasting the mash and pelleted diets results, both without the EC, by means of simple contrast analysis (P=0.0052).

As for thigh and drumstick yield, there was significant contrast between pelleted control diet and pelleted diet without EC. Broilers fed pelleted diet without EC presented lower yield because this diet was reformulated and did not comprise enzymes which would affect nutrient release, improving thigh and drumstick yield.

There was no significant difference in the mineral contents of the bones and in the bone resistance of broilers at 21 days of age (Table 4).

TABLE 3. Pre-slaughter live weight (PSLW, g), breast yield (BY%), and thigh and drumstick yield (TDY%) of broilers fed mash or pelleted diets, with or without enzymes, for 21 days.

Tratamentos	PSLW	BY	TDY
T1 (mash control diet)	793,00	17,94	3,89
T2 (pelleted control diet)	878,00	18,24	4,00
T3 (mash diet reformulated with EC)	798,33	18,33	4,21
T4 (mash diet reformulated without EC)	805,33	18,70	3,78
T5 (pelleted diet reformulated with EC)	891,33	19,03	3,83
T6 (pelleted diet reformulated without EC)	901,66	19,16	3,45
CV (%)	5,779	6,534	9,990
P Value	0,0003	ns	0,0470
Simple Contrast			
T1 *vs* T2	0,0052		ns
T1 *vs* T5	0,0015		ns
T1 *vs* T6	0,0006		ns
T2 *vs* T3	0,0083		ns
T2 *vs* T4	0,0151		ns
T2 *vs* T6	ns		0,0195
T3 *vs* T5	0,0025		
T3 *vs* T6	0,0009		0,0018
T4 *vs* T5	0,0047		ns
T4 *vs* T6	0,0018		ns

EC – enzymatic complex, ns= non significant (P> 0.05), CV= coefficient of variation.

TABLE 4. Means of the variables tibia bone resistance (TBR), in Newton, femur bone resistance (FBR), in Newton, and ashes determination (A, %) of broilers fed mash or pelleted diets, with or without enzymes, for 21 days.

Treatments	TBR	FBR	A
T1 (mash control diet)	7583,33	9750,00	52,381
T2 (pelleted control diet)	10916,66	10333,33	52,186
T3 (mash diet reformulated with EC)	8333,33	9583,33	51,533
T4 (mash diet reformulated without EC)	8166,66	10416,66	51,708
T5 (pelleted diet reformulated with EC)	9083,33	11083,33	51,498
T6 (pelleted diet reformulated without EC)	9500,00	9250,00	54,168
CV (%)	25,187	15,192	3,823
P Value	ns	ns	ns

EC – enzymatic complex, ns= non significant (P> 0.05), CV= coefficient of variation.

The results of breast muscle color (Pectoralis major) of broilers at 21 days of age are presented in Table 5. There was no significant effect of the treatments on the color of the broilers´ meat. The color of the meat may vary in function of the biochemical characteristic of the muscle, the species, age, sex, breed, nutrition, intramuscular fat, and slaughter conditions (NORTHCUTT et al., 1997). The skeletal muscle of birds comprises a myoglobin-poor white muscle composed by glicolitic fibers, and red muscle constituted predominantly by oxidative fibers with low lipid stores (BANKS, 1992). The tonality varies according to the oxygenation (or oxidation) state of myoglobin and depends on the chemical condition of this pigment, as well as the muscle structure, which reflects the light, and external factors such as oxygenation and temperature. These aspects are important because, besides the productive characteristics, meat quality, especially sensorial characterisitcs such as appearance, tenderness and color are required by the consumer (BERAQUET, 2000).

TABLE 5. Color of the breast muscle (Pectoralis major) of broilers at 21 days of age, measured by the L*a*b* system (L= luminosity; a= red index; b= yellow index)

Treatments	L	a	b
T1 (mash control diet)	42,54	9,86	2,82
T2 (pelleted control diet)	41,69	10,09	2,75
T3 (mash diet reformulated with EC)	43,40	8,59	2,99
T4 (mash diet reformulated without EC)	42,95	9,32	2,81
T5 (pelleted diet reformulated with EC)	42,77	9,51	3,75
T6 (pelleted diet reformulated without EC)	43,20	10,44	3,75
CV (%)	8,15	21,59	71,48
P Value	0,7427	0,1291	0,6291

EC – enzymatic complex, ns= non significant (P> 0.05), CV= coefficient of variation.

CONCLUSIONS

Diet pelletization at temperature of 75ºC does not produce a deleterious effect at the activity of the enzymatic complex used. Furthermore, the use of pelleted rations improve productive indices of broilers raised until 21 days of age.

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