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Comparisom of Ileal Digestible Versus Total Amino Acid Feed Formulation on Broiler Performance

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Abstract: This study was conducted to compare the effect of feed formulation based on ileal digestible versus total amino acid on broiler performance. Two experimental diets formulated to meet nutrient requirements based on total amino acids (NRC) and/or recommended ileal digestible amino acids (Creswell and Swick). One hundred and twenty days old chicks were randomly assigned to 2 dietary treatments with 5 replicates of 12 chicks each. Body Weight Gain (BWG) and feed intake were recorded for periods of 1-21, 22-41, 42-47 and 1-47 days. Chicks were individually weighed on day 7, 21 and 47 to determine the group uniformity. Chromic oxide (0.3%) was used in diets to evaluate the passage time of feed through the gastrointestinal tract on day 16 and 32. At the end of experiment, 1 bird with the average pen weight from every pen was selected and slaughtered to measure carcass yield, breast, thigh and drum sticks, abdominal fat, gut, gizzard and ceca weights. The results showed that birds fed diet formulated on the digestible amino acid basis had higher BWG, breast yield and lower feed to gain ratio and abdominal fat pad than those fed diet on total amino acid basis. Transit time of feed was not affected by feed formulation, but increased as birds aged. Flock uniformity reduced over time and was not influenced by type of diet.

Key words: Digestible amino acids, total amino acids, broiler, performance

INTRODUCTION

Recent interest in poultry feed formulation has led to take into account the digestible amino acid rather than total. Several major factors are influenced when birds fed diet formulated based on Digestible Amino Acid (DAA) including: lowering total feed cost, nitrogen output, environmental pollution and heavier and leaner bird with an improved feed to gain ratio. Breast yield which is strongly correlated with increased body protein growth. Feeding birds based on DAA seems to more closely meet the requirements for maintenance and production (Parsons, 1986; Johns *et al*., 1986). For these reasons, many trials have been carried out to determine the digestible amino acids in a range of feedstuffs using precision-fed caecectomized rooster assay and/or ileal digestible amino acids method (Johns *et al*., 1986; Sibbald, 1987; Parsons, 1986; Firman, 1992; Perez *et al*., 1993; Rostagno *et al*., 1995; Fernandez and Parsons, 1996; Huang *et al*., 2000; Lemme *et al*., 2001). Thus, it is important to know digestibility coefficients for individual amino acids in feed ingredients on 1 hand and the requirements of DAA on the other hand. Similarly, Green (1986), Jolly (1989) and Albino *et al*. (1992) had demonstrated the advantages of using DAA in many experiments.

The objective of this study was to compare the effect of diet formulation based on Ileal digestible versus total amino acid on broiler performance.

MATERIALS AND METHODS

One hundred and twenty days old Ross 308 male broiler chicks were randomly divided into 10 replicates 12 chicks each. Two diets were formulated to meet nutrient requirements based on total amino acids (NRC, 1994) and/or recommended ileal digestible amino acids (Creswell and Swick, 2001). Each replicate pen birds was randomly assigned to 1 dietary treatment in order to have 5 groups per treatment and fed starter, grower and finisher diets for 1-21, 22-41 and 42-49 days of age, respectively.

The composition and nutrient content of experimental diets is shown in Table 1. The chicks were kept on floor pens (1×1 m), covered with fresh sawdust. Feed was offered *ad libitum* and water was freely available during the whole period. Birds were exposed to a 23 h light: 1 h dark program.

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Table 1: Composition of experimental diets formulated based on total (TAA) and/or Digestible Amino Acids (DAA)

	Starter		Grower		Finisher	
Ingredients (%)	TAA	DAA	TAA	DAA	TAA	DAA
Corn	51.48	45.70	59.18	55.0	60.10	59.64
Soybean meal	26.00	32.00	21.70	30.95	17.50	28.00
Wheat	2.50	2.15	-	-	-	-
Wheat bran	1.00	2.57	-	-	-	-
Sunflower meal	6.00	6.00	7.00	4.50	10.00	2.50
Corn gluten meal	5.00	5.00	5.00	2.50	5.00	1.80
Sunflower oil	2.90	2.80	3.10	3.37	4.10	4.40
Limestone	1.48	1.95	1.57	1.84	1.57	1.80
Dica-phosphate	1.55	0.95	1.40	1.00	0.92	1.00
Sodium chloride	0.38	0.23	0.39	0.29	0.22	0.31
Vit and min[1]	0.50	0.50	0.50	0.50	0.50	0.50
Hcl-lysine	0.08	0.09	0.14	-	0.09	-
DL-methionine	0.13	0.06	0.02	0.05	-	0.05
Nutrient content						
ME (Kcal kg^{-1})	3000	3000	3100	3100	3200	3200
CP (%)	21.50	21.43	19.96	19.26	19.09	17.39
Ca (%)	0.95	0.95	0.91	0.91	0.89	0.89
Av.P. (%)	0.42	0.42	0.40	0.40	0.38	0.38
Total lys (%)	1.03	1.18	0.97	1.05	0.85	0.95
Total Met (%)	0.49	0.45	0.37	0.4	0.34	0.37
Total Met+Cys (%)	0.84	0.83	0.70	0.73	0.66	0.68
Total Thr (%)	0.78	0.87	0.72	0.79	0.68	0.72
Dig.Lys (%)	0.92	1.07	0.88	0.93	0.78	0.84
Dig.Met (%)	0.48	0.44	0.36	0.38	0.34	0.35
Dig.Met+Cys (%)	0.79	0.78	0.66	0.69	0.63	0.63
Dig.Thr (%)	0.62	0.69	0.58	0.62	0.55	0.56

[1]Supplied/kg of diet: 10000 IU vitamin A, 9790 IU vitamin D_3, 121 IU vitamin E, 2 mg vitamin K_2, 0.02 mg vitamin B_{12}, 4 mg thiamine, 0.0044 mg riboflavin, 22 mg niacin, 4 mg pyridoxine, 0.03 mg biotin, 1 mg folic acid, 40 mg Ca-panthotenate, 840 mg choline chloride, 0.125 mg etoxycoin, 60 mg Zn-sulfate, 100 mg Mn-sulfate, 100 mg Cu-sulfate, 0.2 mg Se, 1 mg I, 50 mg Fe

Body weight gain and feed consumption were recorded at the end of each period following a feed withdrawal for 4 h. Mortality was daily recorded as it occurred. Gain and feed intake of each replicate group was adjusted for mortality (back-calculated to the day of death) and used to calculate a corrected feed to gain ratio. The birds were individually banded and weighed at 7, 21 and 47 days of age to determine the flock uniformity. The number of chicks within ±10% of the average pen weight was calculated as the percentage of uniformity (flock uniformity). The Passage Time of Feed (PTF) was determined for each group of chicks on day 16 and 32 after 4 h of starvation. The PTF was measured as the difference between the time of presenting the marked diet (0.3% chromic oxide as a nondigestible marker) and the time of green excreta apperance. The litter was covered with a white clean sheet each time and examined every 10 min, until the 3rd green excreta drop was appeared. Passage times of 3 drops were averaged as the PTF for each replicate birds. At day 47, after a 12 h fasting, one bird/pen (close to the average pen weight) was weighed individually and slaughtered to measure the carcass yield, breast, thigh and drum sticks (legs), abdominal fat, gut, gizzard and ceca weights.

Data were arranged and analyzed in a completely randomized design using the GLM procedure of SAS (SAS Institute, 1999). Statistical significance between treatment means were compared using the LSD test ($p<0.05$).

RESULTS AND DISCUSSION

The body weight gain and feed to gain ratio of broiler chicks fed diets formulated based on TAA and/or DAA is shown on Table 2. Birds fed diet formulated based on Digestible Amino Acid (DAA) had a greater BWG ($p<0.05$) than those fed diet formulated based on Total Amino Acid (TAA) in every and the whole experimental period. The FCR was significantly ($p<0.05$) improved when diet was formulated based on DAA as compared to TAA in each and whole periods. Improved BWG and feed to gain ratio in DAA fed birds is due to a more balanced nutrients, absorption and protein synthesis which was influenced by the diet formulated based on DAA. Fernandez *et al.* (1995) reported that formulating diets contained cottonseed meal on a digestible amino acid basis resulted in a better BWG, feed intake and feed conversion ratio as compared to those fed diet formulated on a total amino acid basis. Wang and Parsons (1998) conducted 2 experiments to evaluate formulation of diets contained high or low quality meat and bone meal on TAA vs. DAA basis compared to a corn-soybean meal

Table 2: Body weight gain, feed to gain ratio, flock uniformity, passage time of feed, carcass and gastrointestinal parts of broiler chicks fed diets formulated based on Digestible (DAA) or Total Amino Acids (TAA)

	Body weight gain (g/b/period)				Feed to gain ratio (g feed/g gain)			
Diets based	0-21	22-41	42-47	0-47	0-21	22-41	42-47	0-47
DAA	470[a]	1060[a]	535[a]	2065[a]	1.75[b]	2.20[b]	2.24[b]	2.14[b]
TAA	382[b]	865[b]	430[b]	1585[b]	2.05[a]	2.35[a]	2.42[a]	2.32[a]
SEM	18.9	42.1	34.8	73.4	0.043	0.096	0.015	0.043

	Flock uniformity (%)			Passage time of feed (min)	
Diets based	Day 7	Day 21	Day 47	Day 16	Day 32
DAA	59.8[a]	63.0	61.2	155[a]	193[a]
TAA	51.2[b]	60.1	60.3	163[b]	201[b]
SEM	8.01	6.30	5.44	2.05	2.08

	Carcass and carcass parts				Gastrointestinal parts		
Diets based	Carcass[1] (%)	Breast[2] (%)	Legs[3] (%)	AF[4] (g)	Gut[5] (g)	Gizzard (g)	Ceca (g)
DAA	72.30	33.50[a]	28.30	41.00[b]	180.00[a]	34.60	8.00[a]
TAA	71.20	29.70[b]	27.90	58.30[a]	166.00[b]	33.90	6.90[b]
SEM	0.20	0.18	0.11	3.99	8.55	2.00	0.31

[a-b]Means within a column with different superscript differ significantly ($p<0.05$). [1]Carcass excluding skin, head, feet and edible organs, given as % of live body weight, [2]Breast and legs skinless with bone, given as % of carcass weight, [3]Thigh and drum sticks, [4]Abdominal fat, [5]Gut weight including esophagus to vent

control diet. Their resuls indicated that formulation of diets based on digestible AA yielded better growth than did formulation of diets based on total AA. Similar findings were observed when better performance obtained with diets balanced on DAA as compared to a TAA basis (Green, 1986; Jolly, 1989; Albino *et al*., 1992). Rostango *et al*. (1995) reported that diet formulated based on digestible amino acids yield more consistent bird performance.

The uniformity of chicks fed diet formulated based on digestible or total amino acids is shown on Table 2. Eventhough the flock uniformity was significantly ($p<0.05$) improved in birds fed diet formulated based on DAA at day 7, but the type of diet formulation did not have an effect on flock uniformity measured on 21 and 47 days of age. Considering digestible amino acids in the ration is expected to allow a greater number of chicks to achieve their growth potential and appetite over the brooding period after which, they are better able to cope with poor quality rations. Factors that may negatively affect flock uniformity are: age, strain, sex, variability in initial chick weights, level of nutrients, feed competition, feed passage rate and lighting programs. Heath and Owens (1982) suggested that birds with higher uniformity is a necessity to obtain more uniform breast cuts. Passage time of feed was significantly ($p<0.05$) reduced when chicks fed diet formulated on DAA basis as compared to TAA basis (Table 2). Passage time was increased as birds aged. Diet is the most important factor affecting PTF (Duke, 1989). Passage time of feed is usually determined to evaluate the utilization of nutrients such as amino acids, as expressed by digesta motility variations within the digestive tract that may be imposed by feed ingredients (Ritz *et al*., 1995).

Carcass yield and leg weight as a percent of body weight were not altered through feeding birds on DAA and/or TAA basis (Table 2). Whereas, birds fed diet formulated on DAA basis had a significantly ($p<0.05$) higher breast yield as compared to those received diet based on TAA (33.5 vs. 29.7%). The diet with higher quality ingredients, used to formulate diet based on DAA probably delivering more of available amino acids to birds and consequently higher accretion of protein occurs in breast, with lower abdominal fat pad ($p<0.05$). Higher weight ($p<0.05$) of gut and ceca may be related to higher activity of these organs in birds fed diet formulated based on DAA. Other researchers reported that, although, the yield of carcass, breast fillet, thighs, liver, gizzard and heart of birds received diet formulated on digestible amino acid basis were similar to those fed diet based on total amino acid, but it produced more profit (Marinov,1984; Rostagno *et al*., 1995; Dimcho Djouvinov *et al*., 2005).

CONCLUSION

Feeding broiler chicks based on digestible amino acids improves birds performance and profitability. The more balanced available nutrients which, may be provided from high quality ingredients used when formulating diets on digestible amino acids basis seems to increase gut motility, higher breast yield and lower abdominal fat pad.

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