AJINOMOTO

AJINOMOTO ANIMAL NUTRITION

AJINOMOTO HEARTLAND, INC.

POULTRY RESEARCH REPORT 9

The effect of varying protein, amino acids and protein source on the performance of commercial male turkeys

Objective

To determine the effect of relaxing minimum protein restrictions using the commercially available amino acids methionine, lysine and threonine on several performance traits of commercial male turkeys with varying amino acid levels and two protein sources.

Experimental Procedures

Animals

1152 male Nicholas poults were assigned to 12 dietary treatments x 8 replications x 12 birds per pen. Body weights and feed consumption were determined at several ages and the incidence of leg abnormalities was determined at 20 weeks of age.

One bird per pen, selected to represent the median weight within that pen, was assessed for carcass quality characteristics at the conclusion of the study.

Diets

A description of the dietary treatments is given in Table 1 and the composition and nutrient content of selected diets are given in Table 2 and 3. Due to the large number of experimental diets and periods, the composition of all diets is not given.

All diets were either corn-soybean meal or corn-soybean meal-animal protein based. All diets were formulated to contain similar energy levels within an age period and minimum levels of other nutrients in proportion to energy as recommended by NRC (1984) with the exception of CP and essential amino acids as indicated in Table1. Methionine, lysine and threonine were used as commercial amino acid sources.

Table 1. Dietary treatments

Diet	Major Protein Source	Protein Stauts[2]	Amino Acid Level[3]
1	Soybean Meal	Fixed	90
2	Soybean Meal	Fixed	100
3	Soybean Meal	Fixed	110
4	Soybean Meal	Variable	90
5	Soybean Meal	Variable	100
6	Soybean Meal	Variable	110
7	SBM + Propak[1]	Fixed	90
8	SBM + Propak	Fixed	100
9	SMB + Propak	Fixed	110
10	SMB + Propak	Variable	90
11	SMB + Propak	Variable	100
12	SMB + Propak	Variable	110

[1]Blended animal protein product. (H.J. Baker & Bro. New York).
[2]Fixed = 90, 100 or 110% of NRC (1984) crude protein minimums corresponding to amino acid level.
Variable = No crude protein minimums.
[3]90, 100 or 110% of NRC (1984) minimums for all essential amino acids.

Table 2. Composition and nutrient content of selected test diets 0-4 weeks of age				
	Diet #			
Ingredient	2	5	8	11
Corn	41.69	48.36	49.29	51.20
Soybean Meal	51.19	45.22	37.17	34.58
Propak[1]	---	---	10.00	10.00
Fat	2.12	1.21	---	---
DL-Methionine	0.18	0.24	0.05	0.07
L-Lysine HCl	---	0.11	---	0.04
Others[2]	To 100%			
Analysis[3]				
ME (Kcal/kg)	2800	2800	2800	2800
CP (%)	27.99 (28.10)	25.67	27.99 (28.28)	26.90
Lysine (%)	1.68 (1.69)	1.60	1.67 (1.75)	1.60
TSAA (%)	1.06 (1.13)	1.06	1.06 (1.14)	1.06

[1]Blended animal protein product. (H.J. Baker & Bro. New York).
[2]Dicalcium phosphate, limestone, salt, vitamin mix, mineral mix, inert filler
[3]Values in parenthesis represent analyzed values

Table 3. Composition and nutrient content of selected test diets 8-12 weeks of age				
	Diet #			
Ingredient	2	5	8	11
Corn	57.61	62.22	66.38	67.01
Soybean Meal	35.96	31.72	21.74	21.14
Propak[1]	---	---	10.00	10.00
Fat	2.60	2.00	0.08	---
DL-Methionine	0.10	0.14	---	---
L-Lysine HCl	0.23	0.38	0.27	0.30
Others[2]	To 100%			
Analysis[3]				
ME (Kcal/kg)	2900	2900	2900	2900
CP (%)	25.99 (25.89)	23.86	25.99 (25.42)	24.80
Lysine (%)	1.53 (1.57)	1.50	1.50 (1.66)	1.50
TSAA (%)	0.90 (1.00)	0.90	0.96 (1.00)	0.93

[1]Blended animal protein product. (H.J. Baker & Bro. New York).
[2]Dicalcium phosphate, limestone, salt, vitamin mix, mineral mix, inert filler
[3]Values in parenthesis represent analyzed values

Results

Table 4. Main effects of amino acid level, protein level and protein source on male turkey performance							
	Amino Acid Level (% of NRC, 1984)			Protein Level		Protein Source	
	90	100	110	Min.	No Min.	SBM	SBM/ Propak
8-wk Body wt (kg)	2.75[c]	3.00[b]	3.17[a]	2.97	2.97	2.94[b]	3.01[a]
16-wk Body wt (kg)	9.69[c]	10.24[b]	10.51[b]	10.12	10.17	9.96[b]	10.34[a]
20-wk Body wt (kg)	12.95[b]	13.34[a]	13.55[a]	12.23	12.33	12.97[b]	13.59[a]
0-20 wk Feed:Gain	3.07	3.10	3.04	3.08	3.06	3.12[b]	3.02[a]
incident of minor Leg problems (%)[1]	33.65	35.94	35.94	40.14[a]	30.21[b]	38.06	32.29
16-wk Litter Score[2]	3.00[a]	2.66[ab]	2.41[b]	2.83[a]	2.54[b]	2.87[a]	2.50[b]
20-wk Litter Score[2]	1.63	1.69	1.97	1.85	1.67	1.87	1.65
Dressing (%)[3]	77.44	77.82	77.33	77.33	77.73	77.38	77.68
Abdominal Fat (%)[3]	1.00	0.91	0.86	0.83[b]	1.02[a]	0.94	0.91
Breast Weight (g)	2852[b]	3126[a]	3138[a]	3029	3048	2949[b]	3128[a]
Breast (%)[3]	28.46[b]	29.98[a]	29.80[a]	29.51	29.32	29.25	29.58

[a-c]Means within a row and main effect not sharing a common superscript are significantly different (P<.05)
[1]Determined by examining walking ability of all birds at 20 weeks of age
[2]1=dry, 3= wet
[3]Using live weight as a divisor

Discussion

Means of several performance characteristics for the three main effects are given in Table 4. A number of additional measurements were taken but will not be discussed due to the magnitude of the study. The variables discussed are considered of primary importance to the turkey industry. Interactions between main effects were generally found to be insignificant and of minimal consequence to the interpretation of the results. Therefore, only the main effects of amino acid level, protein level and protein source will be discussed.

Amino Acid Level

These data clearly demonstrate that 90% of NRC recommendations for amino acids is insufficient to support maximum growth during any stage of development. Comparing the 100 and 110% NRC levels, these data support a requirement for the latter up to 16 weeks of age but indicate that the NRC (1984) recommended levels are probably adequate from 16 to 20 weeks of age.

Reasons why the NRC (1984) amino acid recommendations appear inadequate to support maximal growth in early stages can only be speculated upon. It is well known that both the growth and carcass characteristics of the commercial turkey have changed drastically over the last 15 years. The capacity for lean tissue deposition may have increased at a faster rate than that of appetite, resulting in a corresponding greater requirement for amino acid concentration in the diet. Further research is needed to substantiate this.

Increasing the amino acid concentration of the diet resulted in a significant improvement in litter score at 16 weeks of age. No corresponding changes in the incidence of leg abnormalities were apparent.

Reducing the amino acid level from 100 to 90% NRC resulted in a significant decrease in both breast yield and breast percentage. At least part of the reason may be that the lowest amino acid group was at an earlier stage of physiological development as reflected by the reduced body weights (it is well known that breast proportion increases as the bird matures). However, the reduction in final body weight from 100 to 90% NRC treatment was only 2.9% (13.34 vs. 12.96 kg) while the reduction in breast percentage was 5.1% (29.98 vs. 28.46%). These data therefore suggest that an amino acid deficiency is more detrimental to carcass quality than to rate of growth.

Protein Level

Placing a minimum crude protein level restriction had variable effects on the diet formulations. Differences between diets with and without minimum restrictions varied from 0 to 2.63% in crude protein (not shown) and were dependent upon the next limiting amino acid after either methionine + cystine, lysine and/or threonine (these amino acids were added where needed). Generally, crude protein differences were higher when "Propak" was not included and at earlier stages.

There were no significant effects of protein level on growth at any stage provided that the minimum amino acid levels were maintained. The fact that growth was numerically greater in the absence of protein restriction provides definitive evidence that amino acids rather than crude protein, per se, are required for maximum growth when commercially available ingredients are used.

The incidence of minor leg problems was significantly reduced when minimum protein restrictions were removed from the formulations. This observation agrees closely with that reported by Ferket (1989) where a reduction in protein level from 100 to 82% of NRC (1984) resulted in a decrease in total leg problems from 20.8 to 11.7% with no significant change in final body weights.

Although the mechanism by which protein reduction reduces leg problems is not clearly understood, the possibility of a reduced body weight and a corresponding reduction of stress on leg bones can be dismissed. Possible mechanisms may include: 1) excess nitrogen metabolism leading to renal hypertrophy and a consequential impairment in the osteognesis process; 2) high protein resulting in an effective amino acid imbalance adversely affecting calcium, phosphorus or Vitamin D_3 metabolism; and 3) poor litter conditions resulting in footpad dermatitis, discomfort and leg problems. The significant improvement in 16 week litter score resulting from decreased protein supports the latter mechanism.

No significant protein effects were observed for carcass quality with the exception of abdominal fat, which increased from 0.83 to 1.02% with decreasing protein levels. This would likely be of minimal consequence to the producer since dressing percentage and breast weight, the most economically important characteristics, were unaffected by protein level.

Protein Source

The addition of 10% animal protein blend and a corresponding reduction in soybean meal significantly and substantially increased growth at all stages, feed conversion and breast yield. An improvement in litter score was also observed.

Possible reasons for the enhanced performance with the animal blend may be: 1) higher than anticipated levels of limiting amino acids; 2) higher than anticipated metabolizable energy, or 3) a reduction of poorly digestible carbohydrates contained in soybean meal. Although 2) and 3) cannot be substantiated by this experiment, amino acid analysis has revealed that total lysine levels tended to be higher in the propak containing early grower diets and levels of sulfur amino acids, lysine and threonine tended to be higher in the propak containing finisher diets (not shown).

Conclusion

The experiment demonstrates that:

1) NRC (1984) recommendations for amino acids may be insufficient to support maximum growth during early stages of development;

2) amino acid deficiencies have a greater detrimental effect on breast yield than on market weights;

3) removal of protein minimums has no effect on growth but improves litter conditions and reduces the incidence of leg abnormalities; and

4) the replacement of soybean meal with 10% animal protein blend improves growth rate, feed efficiency and carcass quality possibly due to an underestimated content of limiting amino acids.

Bibliography

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