FATS AND PROTEINS RESEARCH FOUNDATION, INC.

Director's Digest

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ENERGY AND AMINO ACIDS FOR LAYERS

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NOTE: *Dr. Craig Coon presented this paper at the 1993 Minnesota Nutrition Conference. F.P.R.F. has sponsored many laying hen trials containing supplemental fat with some demonstrating a significant response to the added fat while others did not. This study evaluated the response of increased energy with the addition of Total Sulfur Amino Acids in layer rations. Increasing the level of Total Sulfur Amino Acids may be necessary for consistent results when laying rations contain supplemental fat.* *FDB*

INTRODUCTION

The present laying hen utilized by the industry has been genetically selected to initiate lay at an earlier age, produce more egg mass, and consume less feed than layers of the past. Feed formulations are utilized that provide the daily intake of key nutrients such as protein, amino acids, calcium, phosphorus, and energy. During the past 10-20 years, the Breeder's Management Guide for the Commercial Layer has recommended substantial dietary increases in these nutrients in feed formulations to allow maximum performance. Higher levels of protein and amino acids have also been encouraged in modern feed formulas because of their stimulus to egg size. The increase in dietary protein levels in feed formulas is usually from feedstuffs with lower metabolizable energy levels thus nutritionists have been forced to add fat to keep dietary energy levels equal to the past. Besides the changes that have occurred in present feed

formulations, today's commercial layer has been selected for lower feed consumption and improved feed efficiency. These combined changes have created a need to further study amino acid requirements of the commercial layer. The objectives of the experiments reported herein are to evaluate the need for methionine and total sulfur amino acids (TSAA) in pre-peak layer diets and post-peak diets, evaluate sulfur amino acid levels needed in feed formulas with and without added fat, evaluate the need of sulfur amino acids and dietary energy in different temperatures, and determine if lower protein diets with added amino acids provide equal performance to higher protein diets.

EXPERIMENTAL DESIGN

Nine hundred and twelve 30-week old layers, four hundred and fifty-six layers of Strain A and equal number of Strain B, were housed in a Patchett cage system with automated belt manure removal system. The layers were housed 6 pullets/cage with each pullet provided 62 square inches of cage space in the 19 1/4" x 19 5/8" cages. The layers were housed at 70^0 F and given a 16 hour continuous light:8 hour dark photoperiod. The hens from each strain were divided into 19 groups of 48 hens each. The layers were fed one of 19 test diet regiments that consists of three levels of added dietary fat (0, 2, and 4%) and 6 daily intakes of TSAA (600 mg, 650 mg, 700 mg, 750 mg, 800 mg, and 860 mg) as shown in Table 1. The layers were weighed at 30 weeks, 34 weeks, 38 weeks, 46 weeks, 54 weeks and 64 weeks. The egg number and mortality were recorded daily and egg weights taken on one day's eggs per hen group/week. The eggshell quality (specific and SWUSA) were determined at 30 weeks, 40 weeks, 52 weeks, and 64 weeks. Feed consumption was determined for each 28 day laying period along with hen-day production. The feed consumption was measured weekly from select replicates for each test group to evaluate the need to change diets to maintain the TSAA intake throughout the 9 twenty-eight day periods. The consumption of each test diet providing the test TSAA was accumulated for each group for each 28-day laying period. The average egg weights per 28 day period was multiplied by hen-day % egg production to determine egg mass/day. Feed efficiency was determined by grams of feed/grams of egg mass. Egg composition was measured by separating the yolk, albumen, and shell plus membrane on same days as eggshell quality measurements.

RESULTS WITHOUT FAT BUT INCREASED LEVELS OF SULFUR AMINO ACIDS

Strain A layers fed the basal diets without added fat did not show an egg production, egg weight, or egg mass response to added methionine (Table 8). The Strain B layers consumed slightly more feed of the basal without added fat thus dietary energy may have been less limiting. The Strain B layer did not produce a significant increase in egg number or egg weight but the increases were almost significant. The Strain B layers had a 87% hen/day egg production with 650 mg of TSAA compared to only 81.5% for hens consuming 600 mg. The amount of difference needed for significance at the .05 level was 6.19%. The Strain B hens produced eggs approximately 1 gram larger with increased methionine and TSAA levels but with the experiment a 2 gram increase was required. The Strain B hens consuming 750 mg TSAA with the no fat diets produced a significant 3.9 g increase in egg mass.

RESULTS WITH 2% FAT AND INCREASED LEVELS OF SULFUR AMINO ACIDS

Strain A layers consuming the 2% added fat tended to show an increase in egg number as methionine and TSAA intakes were increased. The mean egg production for the Strain A layer for the post peak 34 week period was 84.6% compared to 81.8% for layers consuming 600 mg TSAA. The egg weights of Strain A hens significantly increased 2.2 g when consuming the highest level of methionine and TSAA with the 2% fat diet compared to the hens consuming the 600 mg levels. The Strain A layers also showed similar significant improvement in egg mass production with intakes of 750 to 850 mg day. The Strain B layers fed the 2% fat diet had a peak egg production of 87.9% with 650 mg consumption of TSAA. The same layers produced a 59 gram egg and 51.8 gram egg mass. The egg weight increased 1 gram for the hens fed 650 mg TSAA and the egg mass increased a significant 3 g/day compared to hens consuming 600 mg TSAA.

RESULTS WITH 4% FAT AND INCREASED LEVELS OF SULFUR AMINO ACIDS

The Strain A layers fed the 4% fat diets and consuming 700 mg TSAA produced hen-day egg production of 86.6%. The Strain A layer consuming 700 mg TSAA produced the maximum egg mass of 50.7 grams for all treatments with this Strain. The Strain A layer fed the 4% fat diet produced significantly larger eggs with the higher levels of TSAA (750 and 850 mg) but the egg numbers for these hens dropped to the lowest for this strain. The research seems to show than hens can produce a maximum egg mass and if the weight of eggs becomes too large the number of eggs will drop. The Strain B layer tended to show the same increase in performance with increased TSAA as Strain B layer fed the 2% fat diet. The Strain B layer tended to produce larger eggs with the 4% fat diet and the production of the larger egg also suggested the layer needed 750 mg TSAA for maximum egg mass. The same strain only needed 650 mg for an average egg mass of 51.8 for hens fed 2% fat diets. The difference is the hens fed the 2% fat diet with 650 mg TSAA consumption produced a 59 g egg with 87.9% production and the hens fed 4% fat with 750 mg TSAA produced a 59.8 g egg while maintaining 86% hen-day egg production. The observation of interest is the lower protein diets (14.6 - 16.8% CP depending on intake) utilized for the experiment with proper TSAA levels equaled the high protein diets for egg mass production.

DISCUSSION

The feed consumption of Strain B layers is slightly greater than Strain A layers. The feed consumption adjustments for maintaining the sulfur amino acid intakes for the respective treatment was not separated by Strain because of the complexity of the treatments. The actual intake of Strain A layers for sulfur amino acid intakes will be slightly less because of less feed intake. The actual intake of dietary energy for the 0% fat diets was approximately 275 kcal ME for Strain A whereas Strain B layers had a mean consumption of approximately 289 kcal ME. The Strain A layer had a mean feed consumption for all TSAA treatments of approximately 98-99 g without regard to increasing fat levels. Since the Strain A layer did significantly better with the high fat diets, the research indicates the Strain A layer cannot eat enough energy to maintain peak performance without adding dietary fat. The Strain B layer tended to produce equal egg mass without adding high fat levels to diets. The increase in dietary fat improved the mean feed efficiency for both strains. Both strains had improved overall egg mass production with added dietary fat, but the improvements were much greater for the strain with the lower feed consumption. Strain A layers had the best feed efficiency because they consumed 4-5 grams less feed per day. The mean egg mass output of Strain B layers for each dietary fat level was always greater but the strain difference of 1.6 g/day for hens fed diets without fat was reduced to a difference between strains of .7 g/day with 4% added fat. The most interesting information for the entire experiment is the significant difference (.05) between strains for body weight gain. The Strain B layer was expected to gain the most weight because the layer consumed more feed and produced the highest overall egg mass. The average body weight gain for the two strains (across both dietary fat levels and TSAA levels) was 171 g for Strain A and only 126.6 g for Strain B. The Strain A layer is consuming 4-5 grams less feed while maintaining a larger increase in body weight gain. The Strain A layer is also producing less total egg mass with the lower feed consumption. The Strain A layer is using nutrients to maintain body weight gain with a higher priority than the Strain B.

Table 1. The experimental diets for Experiment 1 and 2.

DIET IDENTIFICATION

(ADDED DIETARY FAT-GRAMS FEED INTAKE/HEN/DAY)

Ingred	0-95	2-95	4-95	0-100	2-100	4-100	0-105	2-105	4-105	0-110	2-110	4-110
						%						
Corn	66.2	63.8	61.3	68.3	65.9	63.5	71	68.6	66.1	73.4	71	68.5
Soy47	18.7	19.2	19.6	16.5	17	17.4	14.4	14.9	15.3	12.5	12.9	13.4
Meat	5	5	5	5	5	5	5	5	5	5	5	5
Fat	0	2	4	0	2	4	0	2	4	0	2	4
Lime	8.9	8.9	8.9	8.9	8.9	8.9	8.46	8.45	8.45	8.07	8.07	8.07
P18.5	0.55	0.55	0.56	0.57	0.57	0.58	0.47	0.48	0.49	0.38	0.39	0.39
Salt	0.33	0.33	0.33	0.33	0.33	0.33	0.3	0.31	0.31	0.28	0.29	0.29
Lys	0.42*	0	0	2.73*	1.80*	.88*	5.08*	4.15*	3.23*	7.26*	6.33*	5.41*
Vit	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Chol	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
T.min	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Meth	9.10*	9.38*	9.63*	8.24*	8.44*	8.75*	7.29*	7.49*	7.69*	6.62*	6.69*	6.89*

*% amino acids added to diet x 1×10^{-2}

Calculated nutrient values: ME,kcal/kg; Percent amino acids = amino acid values x 1×10^{-3}

CP%	16.88	16.88	16.88	16.04	16.04	16.04	15.28	15.28	15.28	14.58	14.58	14.58
ME	2,787	2,870	2,952	2,806	2,889	2,972	2,844	2,927	3,009	2,878	2,961	3,044
TSAA	631	631	631	600	600	600	570	570	570	546	546	546
Meth	375	375	375	355	355	355	336	336	336	320	320	320
Lys	821	825	831	780	780	780	743	743	743	709	709	709
Tryp	199	200	200	186	187	188	175	175	176	164	165	165
Arg	1,106	1,114	1,122	1,030	1,039	1,047	959	968	976	894	902	911
Val	982	976	969	947	941	934	916	910	904	888	882	876
Ile	730	732	733	689	690	692	651	652	654	616	618	619

Table 8. The effect of feeding different levels of dietary fat, methionine, and TSAA on performance of two Leghorn strains from 30 to 64 weeks of age.

Diet Meth:TSAA (mg/hen/day)	Hen-Day Egg Production (%)		Egg Weight (g)		Egg Mass (g/day)	
	Strain A	Strain B	Strain A	Strain B	Strain A	Strain B
0 % Fat						
355:600	81.5	81.5	58.8	58.6	47.8	47.7
405:650	83.4	87.2	57.7	58.3	48.2	50.9
455:700	82.9	83.2	56.9	59.3	47.2	49.3
505:750	80.8	86.6	58.3	59.6	47.1	51.6
555:800	81.5	83.1	58.9	57.8	48.0	48.0
605:850	83.2	81.2	57.3	59.5	47.7	48.3
Means	82.2	83.8	58.0	58.8	47.7	49.3
2 % Fat						
355:600	81.8	84.0	57.8	58.1	47.3	48.8
405:650	81.0	87.9	58.3	59.0	47.2	51.8
455:700	83.6	86.0	57.2	58.3	47.7	50.2
505:750	84.6	87.7	58.3	58.7	49.4	51.5
555:800	83.3	80.6	59.2	59.1	49.3	47.6
605:850	82.6	81.8	60.0	59.0	49.5	48.3
Means	82.8	84.7	58.5	58.7	48.4	49.7
4 % Fat						
355:600	83.3	84.1	58.8	59.0	49.0	49.7
405:650	85.4	84.7	58.9	59.5	50.3	50.4
455:700	86.6	85.4	58.6	58.8	50.7	50.2
505:750	83.4	86.0	59.6	59.8	49.7	51.4
555:800	83.7	85.4	58.6	58.4	49.1	50.0
605:850	80.2	85.7	61.0	58.1	48.9	49.8
Means	83.8	85.2	59.2	58.9	49.6	50.2
Control (19.5% CP: 2900 kcal ME/kg)	82.6	81.8	58.3	60.5	48.2	49.5
Pooled SE	.354		.127		.222	
Critical LSD value (.05)	6.19		2.1		3.857	
P value	.638		.154		.529	

* Superscripts were not shown for the 38 multiple mean comparisons. The critical LSD value represents the difference needed between means for significance at the .05 level.