Evaluation of the Economic and Environmental Impact of Amino Acid Adjusted Laying Rations

Introduction:

Disposal of layer manure represents a great challenge to egg producers in Maine and elsewhere around the nation. The challenge is great because of the inherited characteristic of many of the poultry farms where large numbers of birds in tens of thousands are housed on relatively small egg farms with a very little land-base associated with most of them. From an environmental stand point, both nitrogen and phosphorus are perhaps the most significant nutrients in poultry manure with potential negative impact. Because of the relatively higher amount of nitrogen which is excreted as a result of protein metabolism, efforts to reduce its excretion in the manure will positively impact the environment.

As the level of crude protein increases in the poultry ration to ensure adequate protein intake, the birds' nitrogen intake increases. This usually lead to an increase in the amount of nitrogen excreted in the manure. Consequently, one way to reduce the amount of nitrogen in poultry manure is to reduce the level of protein in poultry ration. This is, however, not easy to accomplish because of the high protein requirements of laying birds, especially early on, during the laying cycle. The level of protein recommended at this period is normally between 19 and 20% of the laying ration.

This project was design to evaluate the impact of reducing the crude protein in the laying ration with adjusting the level of some amino acids to meet the requirements of laying birds. The hypothesis is that amino acid adjusted ration with lower level of crude protein, will have the potential of reducing the excretion of both ammonia nitrogen improving the chicken house environment, as well as reducing total nitrogen content of the manure. It may also have the potential for reducing feed costs. As a result, this will positively impact the water quality by reducing nitrogen discharge into the environment, as well as having the potential to improve the producer's profitability.

This field trial consisted of two separate flocks of chickens: a test flock (fed the amino acid adjusted ration) and a control flock (received the standard laying ration). Both flocks consisted of the same strain of birds, managed similarly and housed in two similar locations. Performance records were kept on the two flocks to evaluate laying performance from 20 to 47 weeks of age. Manure samples were collected every two weeks from June to October, 1993. Samples were submitted for nitrogen analysis to the Analytical Lab, University of Maine, Orono, Maine.

Results and Discussion:

As pointed out above, the main objectives of the project were to evaluate the impact of amino acid adjusted layer ration on: (1) the performance of laying hens; (2) nitrogen content of chicken manure; and (3) the feed cost of producing eggs using the amino acid adjusted ration.

1. **Bird's performance:**

   As Table 1 indicates, both flocks; the control fed the regular laying ration and the test flock fed the amino acid adjusted ration, performed above the strain standards for egg production measured as eggs per hen housed. The control had 164 eggs per hen housed versus 161 eggs per hen housed for the test flock compared to the strain standard of 158 eggs per hen housed. It also shows that there is 3 eggs difference between the control flock and the test flock.

   On the other hand, birds fed the amino acid adjusted ration in the test flock, produced eggs more efficiently than those in the control flock. The feed efficiency measured as pounds of feed per dozen eggs, was 3.23 for birds fed the amino acid adjusted ration versus 3.36 for the control birds. This could offset, at least in part, the difference in egg production pointed out above. Livability for both flocks was very similar and slightly lower than that of the strain standard.

2. **Nitrogen excretion:**

   Table 2 shows the nitrogen content of the layer manure for both the control and the test flocks. This data indicates that the birds fed the amino acid adjusted ration, usually excreted less total nitrogen as well as ammonia nitrogen compared to the birds fed the regular laying ration with higher crude protein level. The nitrogen content of manure from birds in both the control and the test flock are summarized in Table 3. As this data shows, birds fed the amino acid adjusted ration excreted 31% less total nitrogen and 26% less ammonia nitrogen compared to birds fed the regular ration.

3. **Costs and returns:**

   The costs and returns on these two flocks are summarized in Table 4. This data shows that both flocks had a positive return of 17.4 cents per dozen eggs for the amino acids fed flock and 18.7 cents per dozen eggs for the control flock. The data in Table 4 also indicates that there are about 1.3 cents difference in gain between the amino acids fed birds and the control birds. This difference in gain, however, relate directly to the difference in returns (in egg sales) between eggs produced by the amino acid adjusted ration flock and the control flock.

   In fact, feed cost which represents the larger portion of total production costs, favored the amino acid adjusted ration flock. This, despite the fact that the cost of the amino acid adjusted ration was $8.56/100 lb. compared to $8.29/100 lb. for the regular ration. This indicates that the difference in feed price of the amino acid adjusted ration was more than offset by the better feed efficiency of the birds fed the amino acid adjusted ration compared to the control birds. Indeed, if the lower cost anticipated by reformulating the ration based on amino acids rather than crude protein was realized, this financial analysis picture could have dramatically changed in favor of birds fed the amino acids ration compared to the control birds.

Summary:

In summary, the test results showed that birds fed amino acid adjusted ration performed slightly below the control birds in egg production, but still higher than the strain standard. Birds fed the amino acid adjusted ration had a better feed efficiency as measured by pounds of feed per dozen eggs than the control birds fed higher level of crude protein. The test birds on amino acid adjusted ration excreted significantly less total nitrogen and ammonia nitrogen than the control birds. These results indicate that the use of amino acid adjusted ration for laying hens could positively impact the environment by reducing the amount of nitrogen excreted in the manure. It also improved the overall laying house environment by reducing the amount of ammonia nitrogen excreted in the manure.

Table 1. Effect of regular vs. amino acid adjusted ration on the laying performance between 20 and 47 weeks of age.

	Regular Ration	Amino acid Ration	Standard
Livability (%)	95.9	95.2	96.6
Egg production (eggs/H.H.)*	164	161	158
lb. feed/doz. eggs	3.36	3.23	

* Number of eggs per hen housed.

Table 2. Effect of laying ration based on crude protein (regular) or amino acid on nitrogen excretion in cage layer manure.

Sample*	Crude Protein Ration (Control Flock)			Amino Acid Ration (Test Flock)		
	Nitrogen (%)	Ammonia-N (%)	Total N	Nitrogen (%)	Ammonia-N (%)	Total N
1	4.72	0.80	5.52	2.90	0.64	3.54
2	2.57	0.67	3.24	2.90	0.65	3.55
3	4.76	1.29	6.05	3.63	0.52	4.15
4	5.27	1.26	6.53	3.40	0.74	4.14
5	4.44	0.83	5.27	2.40	0.65	3.05
6	3.63	0.68	4.31	3.47	0.84	4.31
7	7.15	1.05	8.20	3.60	0.62	4.22
8	3.49	0.73	4.22	1.73	0.60	2.33
9	4.84	0.83	5.67	3.61	0.68	4.29

* Samples were collected every 2 weeks between June and October, 1993.

Table 3. Nitrogen content of manure from layers fed either regular or amino acid adjusted ration.

	Total Nitrogen	Ammonia Nitrogen
Regular Ration (%)*	5.45 ± 1.37	0.90 ± 0.24
Amino acid Ration (%)*	3.74 ± 0.65	0.66 ± 0.09
Percent difference (%)	**31.4**	**26.7**

* Values are the mean of nine samples ± standard deviation.

Table 4. Financial analysis: Costs and return for layers fed either regular or amino acid adjusted ration.

	--- $ per dozen eggs ---	
	Regular Ration	Amino acid Ration
Egg Sales*	0.655	0.644
Feed Cost	0.278	0.276
Other Costs	0.190	0.194
Total Costs	0.468	0.470
Gain/Loss	+0.187	+0.174
Difference		-0.013

* Average value based on actual selling prices.