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GROWTH AND BLOOD ANALYSES
OF GROWING TURKEYS FED
DEHYDRATED POULTRY ANAPHAGE

Thesis for the Degree of M. S.
MICHIGAN STATE UNIVERSITY
Gibril O. Fadika
1973

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ABSTRACT

GROWTH AND BLOOD ANALYSES OF GROWING TURKEYS FED DEHYDRATED POULTRY ANAPHAGE

By

Gibril O. Fadika

An experiment was designed to study the effect of feeding dehydrated poultry anaphage on the performance and blood constituents of growing turkeys. One hundred fifty-two commercial, 9-week old straight run large white turkeys were used in the study. Poultry anaphage was fed at levels of 5, 10 and 30 percent to the turkeys from 9 to 17 weeks of age. Body weights were taken prior to initiating the experiment (9-week old) and thereafter at 4-week intervals (that is, at 13 and 17 weeks of age). Feed consumption and mortality were recorded for each treatment by replication. At the end of the feeding trial, blood samples were collected from 68 birds (32 males and 32 females), 16 from each treatment by cardiac puncture. These samples were used to determine the plasma uric acid, phosphorous and zinc levels.

A significantly ($P \leq .01$) lower 9 to 13 week body weight gain was observed in the turkeys fed the diet that contained 30 percent poultry anaphage. The overall body weight

gain from 9 to 17 weeks of age was not significantly ($P \leq .05$) altered by feeding dietary poultry anaphage. However, a numerical decrease of 0.33 kg per bird, in comparison to the control group, was observed in the birds that received 30 percent poultry anaphage in their diet and was significant from the control at $P = .061$.

Feed efficiency, despite an attempt to make the diets isocaloric, was inversely related to the level of anaphage in the diet with conversion figures being 3.35, 3.40, 3.48 and 3.63 kg feed per kg body weight gain for the 0, 5, 10 and 30 percent anaphage diet, respectively. Mortality level was not affected by feeding poultry anaphage.

No significant ($P \leq .05$) effect on plasma uric acid levels were observed as a result of feeding poultry anaphage. Plasma phosphorous level was significantly ($P \leq .01$) increased by feeding 30 percent poultry anaphage.

GROWTH AND BLOOD ANALYSES OF GROWING
TURKEYS FED DEHYDRATED POULTRY ANAPHAGE

By

Gibril O. Fadika

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Poultry Science

1973

To my parents
from whom I have received
much more than I will give.

ACKNOWLEDGMENTS

Though the title page by-line contains but a single name, it must be recognized that many people helped make this thesis a reality. The author wishes to acknowledge them.

Primary gratitude is extended to the author's major advisor, Dr. John H. Wolford, associate professor, of Poultry Science, for his ceaseless encouragement and many constructive criticisms and suggestions. My association with him has been one of the most rewarding aspects of my graduate education.

The author extends his sincere appreciation to Drs. C. J. Flegal, associate professor, and H. C. Zindel, professor, of the Poultry Science Department and Dr. P. Markakis, professor, Department of Food Science, for their services as committee members and for their constructive criticism in making this volume a reality.

A word of thanks must be expressed to Mrs. Rose Mary Court, Animal Husbandry Department, for her technical assistance. Space and memory cannot permit due recognition of all, but I am grateful to the many people who assisted me in this research.

Finally, but most important of all, the author is indebted to his parents, Mr. and Mrs. M. L. Fadika, for their generous financial support. Without such an expression of love and understanding, little could have been accomplished.

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INTRODUCTION

One major problem facing the modern intensive poultry producer is manure disposal. During recent years the development and growth of the industry has resulted in the production of tremendous amounts of manure and disposal has become, in many places, a health, environmental and economic problem. On the other hand, of prime concern to the poultry producer is the product cost, of which feed is the major cost item. Thus, cheaper feedstuffs would, therefore, have a profound effect on the economy of poultry production.

Logically, a system of poultry waste management emphasizing utilization would be of value to the poultry producer. This might be an acceptable and partial economic solution to the two problems--manure disposal and feed cost.

The use of animal wastes as fertilizer and the resulting up-take of elements by plants is one of the oldest methods of indirect recycling. However, with the increased concentration of animal units and the expanding suburbia even this recycling method has become an environmental hazard in certain locations. Furthermore, due to the ready availability of chemical fertilizers at a relatively low price, land disposal of organic waste, in many cases is not economically feasible. If this organic waste material could be fed

directly to poultry, thus, eliminating the land disposal cost, the cash value may be sufficient to allow the conversion of a waste product into a valuable by-product.

Although poultry anaphage (Polin, 1972), a dehydrated poultry manure product, has been fed to growing chicks and laying hens, a review of the literature revealed a lack of data on feeding poultry anaphage to turkeys. Thus, this investigation was undertaken to evaluate whether dehydrated poultry anaphage could be substituted for corn in a turkey growing ration.

LITERATURE REVIEW

The inclusion of poultry excreta in poultry diets as a feed ingredient is not a new idea (Rubin et al., 1946); but, the feeding of mechanically dehydrated poultry waste is a relatively new idea (Flegal and Zindel, 1969).

Hammond (1942) found that chickens grew well when dried cow manure was added to low grade growing diets. Hatchability was improved by the addition of cow manure to the diet of laying chickens (Groschke et al., 1947). Palafox and Rosenberg (1951) fed rations containing up to 15 percent oven- and air-dried cow manure to layers and observed that, with 5 and 10 percent supplementation, egg production, egg weight, body weight, hatchability and feed consumption were satisfactory; but, 15 percent oven-dried cow manure significantly depressed egg production.

Rubin et al. (1946) demonstrated that a growth promoting factor for chicks existed in manure collected from hens. Additional information indicating that a growth promoting factor existed for chicks was confirmed by Elam et al. (1954) and Jacobs et al. (1954) by feeding an autoclaved water suspension of poultry litter, Wehunt et al. (1960) by feeding hydrolyzed poultry manure, Fuller (1956) by feeding hydrolyzed poultry litter and Gustava et al.

(1964) by feeding dry chicken manure. However, Warden and Schaible (1961) reported that a significant growth depression occurred in chicks which had access to fresh hen feces. Yates and Schaible (1961) confirmed that fresh hen feces added to the feed of chicks and poults depressed growth but that heated hen feces improved the growth rate of chicks. Treatment of raw hen manure with antibiotics (Warden and Schaible, 1961) or with cobalt (Gapuz et al., 1954 and Gapuz, 1959) improved its growth-promoting value.

Cenni et al. (1969) observed that weight gain to 8 weeks was improved by feeding 10 percent poultry litter but decreased when 20 or 30 percent was fed. Flegal and Zindel (1970a) reported that the 4-week mean body weight of Leghorn-type chicks was not influenced when up to 20 percent dried poultry waste was fed; but, when fed to broiler-type chicks, a reduction in body weight was observed. Feed efficiency was inversely related to the level of dried poultry waste in the diet (Flegal and Zindel, 1970a). That dried autoclaved poultry manure has nutritional value for the broiler chick was shown by Lee and Blair (1972) and McNab et al. (1972) in their studies on non-protein nitrogen sources of poultry. Biely et al. (1972) demonstrated that 5 or 10 percent dried poultry waste in the diet of growing egg-type chicks did not interfere with the physiological well-being of the birds or growth rate and feed efficiency; however, as the level of dried poultry waste

was increased to 20 or 30 percent, growth and feed efficiency were adversely affected.

Durham et al. (1966) fed manure at 10, 25 and 40 percent of the diet to laying hens and observed that feed efficiency decreased almost in proportion to the amount of manure included in the diet. The pullets that received 10 percent manure in the diet produced significantly more eggs; but, feed consumption was increased. However, Hodgetts (1969) reported that the inclusion of dried poultry waste in laying rations resulted in an improved feed efficiency.

Quisenberry and Bradley (1968) fed 10 and 20 percent each of pullet litter, broiler litter and caged layer droppings to laying hens. All diets were adjusted on a calculated basis to be isonitrogenous and isocaloric. No adverse effect was observed on body weight, production rate, egg size, feed conversion or mortality.

Flegal and Zindel (1970c and 1971) reported that feeding 10, 20 and 40 percent dried poultry waste to 26-week old laying hens for 366 days did not significantly affect hen-housed egg production. However, feed efficiency was inversely proportional to the amount of dried poultry waste in the diet. Furthermore, birds receiving either 20 or 40 percent dried poultry waste in their diets did not have body weight increases comparable to the control group.

Flegal and Zindel (1970b and 1971) fed 10, 20 or 30 percent dried poultry waste to 34-week old laying hens for 139 days. In general, the birds receiving diets containing 10 or 20 percent dried poultry waste resulted in similar or superior feed efficiency(s) when compared to the control ration, while birds receiving diets of 30 percent dried poultry waste resulted in feed efficiency(s) somewhat higher than the control ration.

Flegal et al. (1972) and Flegal and Dorn (1971) reported on the effect of continuous recycling dried poultry waste in the diet of 20-week old egg-type chickens for 31 cycles (412 days, recycled approximately every 12 days). At the completion of 31 cycles, hen-housed egg production of the birds fed the diet containing 12.5 percent dried poultry waste was slightly higher (62.4%) than for birds fed the control diet (59.6%) or for the birds fed a diet containing 25.0 percent dried poultry waste (59.2%). It was also observed that those birds fed the diet containing 25.0 percent dried poultry waste consumed 12.6 percent more feed than birds fed either 0 or 12.5 percent dried poultry waste. Mortality was not influenced by the dietary addition of dried poultry waste.

Pisone and Begin (1971) reported that 5 or 10 percent dried poultry manure in the diet of laying hens had little effect on hen-day production, feed intake or body weight increase; however, 20 or 30 percent appeared to reduce body weight gain.

Nesheim (1972) fed laying hens dried poultry manure obtained from commercial cage layers at a level of 22.5 percent for 77 days. No significant difference in rate of production was observed from feeding the dried poultry waste. There were differences in feed consumption and feed conversion which were directly related to the metabolizable energy content of the diets. Body weight gain of the hens fed the dried poultry waste were slightly lower than the control group.

Varghese and Flegal (1972) reported that the continuous recycling of dried poultry waste in the diet of laying hens did not alter the levels of zinc, arsenic, mercury and copper found in kidney, liver, muscle, egg and feces samples from the birds.

OBJECTIVES

1. To investigate the feasibility of utilizing poultry anaphage as a feed ingredient for growing turkeys through data collection on body weight gain, feed efficiency and livability.
2. To investigate the effects of feeding poultry anaphage on the level of the blood constituents--uric acid, phosphorous and zinc.

EXPERIMENTAL PROCEDURE

Commercial, 9-week old straight run Broad Breasted White turkeys¹ were used in this study. A total of 152 birds were assigned by weight to four treatment groups of 38 birds per group. Each treatment group was divided into two replicates of 19 birds per replicate. The birds were housed in 3.0 x 5.4 meter pens located at the Michigan State University Poultry Science Research and Teaching Center. The pen floors were concrete and were covered with wood shavings. Feed and water were provided ad libitum in a 0.7 meter diameter tube-type feeder and a pressure controlled water cup. Mechanical ventilation fans were thermostatically set to maintain a temperature of 21^o C; and, a 12-hour artificial light day was provided from 7:00 a.m. to 7:00 p.m.

Prior to initiating the experiment, the birds were leg banded and weighed. Two replicates of each treatment group were randomly assigned four experimental diets containing 0, 5, 10 or 30 percent poultry anaphage. The feces used for processing into the anaphage product was collected

¹The turkeys were hatched from eggs supplied by Janes Bar Nothing Ranch, Austin, Texas.

from cage laying hens, mechanically dehydrated (Surbrook et al., 1970) and blended in a vertical mixer prior to incorporation into the diets. All diets were similar in protein content, based on the analyzed values of the poultry anaphage reported in Table 1, and energy, based on the 1350 kcal/kg metabolizable energy value reported by Polin et al. (1971). The composition of ingredients was assumed to be that of Adams and Flegal (1969). Composition of the experimental diets used are presented in Table 2. Basically, poultry anaphage was substituted for corn; however, adjustments were also made in the calcium and phosphorous ingredient sources which reflected the level of these two elements in the poultry anaphage.

Feed consumption was recorded for each treatment group by replication and mortality was recorded as it occurred. The feeding period was for 8 weeks (9 to 17 weeks of age). At 17 weeks of age, 16 birds (8 males and 8 females) were selected at random from each of the four treatment groups for collection of blood samples. Blood was collected by the cardiac puncture method, prevented from clotting with heparin and placed in a pyrex centrifuge tube which was suspended in ice. Approximately four hours elapsed from the time the initial samples were collected, centrifuged, plasma decanted and stored in a -12°C refrigerator freezer compartment.

Plasma uric acid was determined by the ultraviolet technique (Sigma, 1968). Plasma zinc was determined by

Table 1. Composition of the poultry anaphage
used in the experimental diets¹

	<u>Percentage</u>
Calcium	6.3
Phosphorous	2.6
Crude fiber	15.6
Ether extract	3.4
Water	6.7
Crude protein	19.5
Non-protein nitrogen	1.5
Actual protein	10.3

¹Analysis completed in the Michigan State
University Biochemistry Department Laboratory.

Table 2. Diet composition

Ingredient	Control	Percentage of Diet		
		Poultry	Anaphage	
		5%	10%	30%
Corn, ground yellow	60.0	54.0	48.2	19.0
Soybean oil meal, 49%	27.0	27.0	27.0	27.0
Alfalfa leaf meal, 17%	2.5	2.5	2.5	2.5
Fish meal, 60%	2.5	2.5	2.5	2.5
Meat & bone meal, 50%	2.5	2.5	2.5	2.5
Animal fat	2.5	4.5	6.0	15.5
Salt, iodized	0.4	0.4	0.4	0.4
Dicalcium phosphate	1.5	1.0	0.3	--
Limestone	0.5	--	--	--
Vitamin-mineral premix ¹	0.6	0.6	0.6	0.6
Poultry anaphage	--	5.0	10.0	30.0

¹Contained per kg premix: 1,320,000 U.S.P. units vitamin A; 3,666,667 I.C. units vitamin D₃; 880 mg riboflavin; 1760 mg pantothenic acid; 7.3 g niacin; 90.9 g choline chloride; 256 mg folic acid; 2.2 mg B₁₂; 1,100 I.U. vitamin E; 294 mg menadione sodium bisulfite; 146 mg thiamine mononitrate; 1.533% Mn; 0.02% I; 0.161% Cu; 0.0051% Co; 1.0% Zn; 0.5% Fe.

Calculated Analysis

Protein, %	21.7	21.7	21.7	21.2
Metab. Energy, kcal/kg	3048	3069	3059	3081
Calcium, %	1.04	1.04	1.19	2.37
Phosphorous, %	0.84	0.86	0.85	1.23

atomic absorption spectroscopy on a Jarrell-Ash atomic absorption spectrophotometer (Model 82-516, Jarrell-Ash Co., Waltham, Mass.) equipped with a Hetco total consumption burner. Duplicate plasma samples were diluted 1:7 with deionized distilled water and aspirated into an air-hydrogen flame at an absorption wavelength of 2480.5 Å⁰. Zinc levels were determined from the recorder charts using a Hewlet-Packard calculator. Plasma phosphorous was determined by a color-metric method using a Coleman Junior II model 6/20 spectrophotometer (Gomorri, 1942). The optical density of the blank vs. the test samples were recorded at 700 m/^u following 45 minutes incubation at room temperature.

Statistical analyses were performed using methods of covariance and analysis of variance (Michigan State University Computer Center, 1969) and Dunnett's Allowance (Dunnett, 1955). Data were considered statistically different at $P < .05$.

RESULTS

Livability was not affected by feeding poultry anaphage to growing turkeys. Two birds receiving the 10 percent dietary level of poultry anaphage died during the 8-week experimental period; however, death was attributed to injury rather than from dietary effect. One bird in the 30 percent poultry anaphage treatment group was eliminated from analysis because the bird was obviously abnormal (undetermined health problem). In terms of appearance the birds that received the poultry anaphage had the same coloring, activity and vitality.

Average body weight of male and female growing turkeys were not significantly ($P \leq .05$) affected by feeding poultry anaphage for eight weeks (Tables 3 and 4); although a trend for an average lowered body weight was observed in the birds fed 30 percent poultry anaphage.

Average body weight gain from 9 to 13 weeks of age was significantly ($P \leq .01$) lower for the birds that were fed 10 and 30 percent poultry anaphage in comparison to the control group (Table 5); but, this trend was not observed during the 13 to 17 week weight gain period (Table 6). During the 13 to 17 week period, birds which were fed poultry anaphage either equaled or exceeded the body weight gain

Table 3. Effect of feeding poultry anaphage on the 13-week body weight of growing turkeys

Treatment	Average Body Weight (kg)		
	Male	Female	Sexes Combined
Control	5.94 ± .20 (21)	4.72 ± .09 (17)	5.39 ± .19 (38)
5% anaphage	5.99 ± .24 (20)	4.67 ± .14 (18)	5.36 ± .21 (38)
10% anaphage	5.92 ± .20 (20)	4.32 ± .14 (16)	5.20 ± .23 (36)
30% anaphage	5.76 ± .23 (17)	4.51 ± .15 (20)	5.08 ± .21 (37)

Source	Sum of Squares	D.F.	Mean Square	F-Value	Significance Level
Treatment (T)	1.5041	3	0.5014	1.508	.215
Sex (S)	67.3801	1	67.3801	202.666	<.001
Replication (R)	1.1176	1	1.1176	3.362	.069
T x S	0.7477	3	0.2492	0.750	.524
T x R	0.0211	3	0.0070	0.021	.996
R x S	0.0235	1	0.0235	0.071	.791
T x R x S	0.1380	3	0.0460	0.138	.937
Error	44.2183	133	0.3325		

± Standard error of mean

(149) Number of birds

Table 4. Effect of feeding poultry anaphage on the 17-week body weight of growing turkeys

Treatment	Average Body Weight (kg)		
	Male	Female	Sexes Combined
Control	7.54 ± .26 (21)	5.99 ± .11 (17)	6.85 ± .23 (38)
5% anaphage	7.64 ± .29 (20)	5.96 ± .11 (18)	6.85 ± .25 (38)
10% anaphage	7.65 ± .20 (20)	5.75 ± .14 (16)	6.80 ± .28 (36)
30% anaphage	7.46 ± .23 (17)	5.68 ± .16 (20)	6.50 ± .25 (37)

Source	Sum of Squares	D.F.	Mean Square	F-Value	Significance Level
Treatment (T)	1.1408	3	0.3803	0.870	.458
Sex (S)	107.4286	1	107.4286	245.796	<.001
Replication (R)	0.0368	1	0.0368	0.084	.772
T x S	0.6745	3	0.2248	0.514	.673
T x R	1.2579	3	0.4193	0.959	.414
R x S	0.6420	1	0.0420	0.0961	.757
T x R x S	0.3887	3	0.1296	0.2965	.828
Error	58.1295	133	0.4371		

± Standard error of mean

(149) Number of birds

Table 5. Effect of feeding poultry anaphage on the 9 to 13-week body weight gain of growing turkeys

Treatment	Average 9 to 13-Week Body Weight Gain (kg)		
	Male	Female	Sexes Combined
Control	2.60 ± .11 (21)	2.09 ± .05 (17)	2.37 ± .09 (38)
5% anaphage	2.66 ± .14 (20)	1.99 ± .10 (18)	2.34 ± .12 (38)
10% anaphage	2.56 ± .11 (20)	1.63 ± .14 (16)	2.15 ± .21 (36)
30% anaphage	2.41 ± .11 (17)	1.79 ± .09 (20)	2.07 ± .11 (37)

Source	Sum of Squares	D.F.	Mean Square	F-Value	Significance Level
Treatment (T)	1.9286	3	0.6429	5.370	.002
Sex (S)	16.9594	1	16.9594	141.666	<.001
Replication (R)	1.0483	1	1.0483	8.7565	.004
T x S	0.7931	3	0.2644	2.208	.090
T x R	0.1056	3	0.0352	0.294	.830
R x S	0.0006	1	0.0006	0.005	.943
T x R x S	0.0484	3	0.0161	0.135	.939
Error	15.9220	133	0.1197		

± Standard error of mean

(149) Number of birds

Table 6. Effect of feeding poultry anaphage on the 13 to 17-week body weight gain of growing turkeys

Treatment	Average 13 to 17-Week Body Weight Gain (kg)		
	Male	Female	Sexes Combined
Control	1.60 ± .11 (21)	1.28 ± .09 (17)	1.45 ± .05 (38)
5% anaphage	1.65 ± .09 (20)	1.29 ± .11 (18)	1.48 ± .08 (38)
10% anaphage	1.73 ± .12 (20)	1.44 ± .10 (16)	1.60 ± .09 (36)
30% anaphage	1.71 ± .08 (17)	1.17 ± .07 (20)	1.42 ± .09 (37)

Source	Sum of Squares	D.F.	Mean Square	F-Value	Significance Level
Treatment (T)	0.5167	3	0.1722	1.680	.174
Sex (S)	4.6493	1	4.6494	45.347	.001
Replication (R)	0.7488	1	0.7488	7.303	.008
T x S	0.2553	3	0.0851	0.830	.480
T x R	1.3993	3	0.4664	4.549	.005
R x S	0.0027	1	0.0027	0.026	.872
T x R x S	0.0904	3	0.0301	0.294	.830
Error	13.6364	133	0.1025		

± Standard error of mean

(149) Number of birds

of the control group. Total weight gain for the 9 to 17 week age period (Table 7) was not significantly ($P \leq .05$) affected by feeding poultry anaphage to growing turkeys; although the treatment significance level was $P = .061$ (Table 7). The arithmetic average body weight gain was 0.34 kg less for the birds fed 30 percent poultry anaphage than for the control group.

Feed efficiency, for the entire 8-week growing period, was inversely related to the amount of poultry anaphage incorporated into the diet (Table 8). In comparison to the control group, 1.5, 3.8 and 8.4 percent more feed was required to produce one kilogram body weight gain, respectively, for the 5, 10 and 30 percent poultry anaphage fed turkeys.

The results of the plasma uric acid analyses are presented in Table 9. Despite a trend for the plasma uric acid to increase as the level of dietary anaphage increased, no significant ($P \leq .05$) effect was noted. An average value of 2.78 mg/100 ml plasma was observed in the control group, in comparison to 3.38 mg/100 ml plasma for the three anaphage fed treatment groups. No significant ($P \leq .05$) difference was noted between the males and females.

The results of the plasma phosphorous analyses are presented in Table 10. A significant ($P \leq .01$) treatment effect was observed with an average of 3.64 mg phosphorous per 100 ml plasma in the control group in comparison to 4.78, 4.72 and 6.02 mg/100 ml plasma respectively, for the 5, 10 and 30 percent poultry anaphage fed treatment groups.

Table 7. Effect of feeding poultry anaphage on the 9 to 17-week body weight gain of growing turkeys

Treatment	Average 9 to 17-Week Body Weight Gain (kg)		
	Male	Female	Sexes Combined
Control	4.20 ± .18 (21)	3.37 ± .10 (17)	3.82 ± .14 (38)
5% anaphage	4.31 ± .21 (20)	3.29 ± .08 (18)	3.82 ± .16 (38)
10% anaphage	4.29 ± .17 (20)	3.07 ± .11 (16)	3.75 ± .18 (36)
30% anaphage	4.11 ± .12 (17)	2.97 ± .09 (20)	3.49 ± .15 (37)

Source	Sum of Squares	D.F.	Mean Square	F-Value	Significance Level
Treatment (T)	1.5232	3	0.5077	2.519	.061
Sex (S)	39.4158	1	39.4158	195.534	<.001
Replication (R)	0.0240	1	0.0240	0.119	.731
T x S	0.8346	3	0.2782	1.380	.252
T x R	2.1444	3	0.7148	3.546	.016
R x S	0.0005	1	0.0005	0.003	.959
T x R x S	0.1213	3	0.0404	0.201	.896
Error	26.8102	133	0.2016		

± Standard error of mean

(149) Number of birds

Table 8. Effect of feeding poultry anaphage on the feed conversion of growing turkeys

Treatment	Feed Conversion (kg feed/kg body wt. gain)		
	9-13 Wks.	13-17 Wks.	9-17 Wks.
Control	2.92	4.04	3.35
5% anaphage	2.84	4.29	3.40
10% anaphage	3.15	3.93	3.48
30% anaphage	3.11	4.38	3.63

Table 9. Effect of feeding poultry anaphage to growing turkeys on the level of plasma uric acid

Treatment	Plasma Uric Acid Level (mg/100 ml)*		
	Male	Female	Sexes Combined
Control	2.59 ± .57	2.97 ± .62	2.78 ± .59
5% anaphage	3.09 ± .39	2.87 ± .75	2.98 ± .57
10% anaphage	3.67 ± .11	3.59 ± .71	3.63 ± .38
30% anaphage	3.19 ± .52	3.88 ± .66	3.54 ± .59

Source	Sum of Squares	D.F.	Mean Square	F-Value	Significance Level
Treatment (T)	6.9979	3	2.3326	1.507	0.225
Sex (S)	0.2823	1	0.2823	0.1823	0.671
Replication (R)	4.7035	1	4.7035	3.039	0.088
T x S	2.7726	3	0.9242	0.5971	0.620
T x R	18.7051	3	6.2350	4.028	0.012
R x S	2.5400	1	2.5400	1.6410	0.206
T x R x S	6.7692	3	2.2564	1.4578	0.238
Error	74.2969	48	1.5479		

* 8 males and 8 females per treatment

± Standard error of mean

Table 10. Effect of feeding poultry anaphage to growing turkeys on the level of plasma phosphorus

Treatment	Plasma Phosphorus Level (mg/100 ml) *		
	Male	Female	Sexes Combined
Control	3.41 ± .20	3.86 ± .24	3.64 ± .22
5% anaphage	4.88 ± .57	4.67 ± .38	4.78 ± .48
10% anaphage	5.09 ± .64	4.35 ± .51	4.72 ± .58
30% anaphage	6.53 ± 1.16	5.51 ± .79	6.02 ± .98

Source	Sum of Squares	D.F.	Mean Square	F-Value	Significance Level
Treatment (T)	433.5893	3	144.5298	233.971	<.001
Sex (S)	0.0848	1	0.0848	0.137	.713
Replication (R)	3.3994	1	3.3994	5.503	.023
T x S	2.9589	3	0.9863	1.597	.202
T x R	5.6377	3	1.8792	3.042	.038
R x S	0.0749	1	0.0749	0.121	.729
T x R x S	0.7661	3	0.2554	0.413	.744
Error	29.6508	48	0.6177		

* 8 males and 8 females per treatment

± Standard error of mean

No significant ($P \leq .05$) difference was noted between the males and females.

The results of the plasma zinc analyses are presented in Table 11. A significant ($P \leq .01$) treatment effect was observed and was due to a lower plasma zinc level observed in the turkeys fed 5 percent poultry anaphage. The 30 percent poultry anaphage fed birds had plasma zinc levels equal to the control fed birds. A significant ($P \leq .01$) sex difference, with lower values being observed in the females, was noted.

An economic comparison of feeding 5 percent poultry anaphage to growing turkeys (9 to 17 weeks of age) is shown in Tables 12, 13 and 14. Based on the isocaloric dietary formulation, feed conversion and body weight gain of this study, 5 percent dietary substitutions of poultry anaphage as an energy source is possible if the poultry anaphage is obtained free of charge (Ingredient Price Level I, Table 14); however, at higher ingredient prices (Ingredient Price Level II, Table 14) poultry anaphage can not be economically justified.

Table 11. Effect of feeding poultry anaphage to growing turkeys on the level of plasma zinc

Treatment	Plasma Zinc Level (mg/100 ml) *		
	Male	Female	Sexes Combined
Control	1.62 ± .11	1.58 ± .02	1.60 ± .06
5% anaphage	1.57 ± .02	1.52 ± .00	1.55 ± .01
10% anaphage	1.58 ± .03	1.58 ± .02	1.58 ± .02
30% anaphage	1.62 ± .02	1.59 ± .03	1.61 ± .02

Source	Sum of Squares	D.F.	Mean Square	F-Value	Significance Level
Treatment (T)	0.0473	3	0.0158	6.302	.001
Sex (S)	0.0272	1	0.0272	10.886	.002
Replication (R)	0.0049	1	0.0049	1.959	.168
T x S	0.0069	3	0.0023	0.921	.438
T x R	0.0171	3	0.0057	2.291	.090
R x S	0.0016	1	0.0016	0.640	.428
T x R x S	0.0084	3	0.0028	1.125	.349
Error	0.1201	48	0.0025		

* 8 males and 8 females per treatment

± Standard error of mean

Table 12. Ingredient prices used for economic evaluation

Ingredients	Price Per Pound ¹ (Cents)	
	2/7/72	1/1/73
Corn, ground yellow	2.5	3.1
Soybean oil meal, 49%	5.0	10.5
Alfalfa leaf meal, 17%	3.3	4.9
Fishmeal, 60%	9.5	15.3
Meat & bone meal, 50%	5.6	10.8
Animal fat, yellow grease	5.8	7.6
Salt, iodized	0.6	0.7
Dicalcium phosphate	5.5	5.5
Limestone	1.0	1.0
Vitamin-mineral premix ²	18.0	20.0

¹The price was taken from the Ingredient Market listed for Chicago in Feedstuffs published by Miller Publishing Co., Minneapolis, Minnesota. To the quoted price a \$0.005 per pound handling and transportation charge was added.

²Estimated price.

Table 13. Cost of the control--no anaphage and 5 percent anaphage diets

Diet	Ingredient Price	Ingredient Price
	Level I (2/7/72)	Level II (1/1/73)
<u>Control</u>		
Ingredient cost ¹	\$ 73.06	\$ 117.41
Mixing & delivery cost	<u>7.00</u>	<u>7.50</u>
Total cost	\$ 80.06	\$ 124.91
Cost/kg	\$.0881	\$.1374
<u>5% anaphage</u>		
Ingredient cost ¹	\$ 71.73	\$ 116.08
Mixing & delivery cost	<u>7.00</u>	<u>7.50</u>
Total cost ²	\$ 78.73	\$ 123.58
Cost/kg	\$.0866	\$.1359

¹Calculated from the data in Table 12 and the diets presented in Table 2.

²No dollar value was assigned to the poultry anaphage used.

Table 14. Economic comparison of feeding growing turkeys 5 percent poultry anaphage from 9 to 17 weeks of age

	<u>Ingredient Price Level I</u>		<u>Ingredient Price Level II</u>	
	Control	5% Anaphage	Control	5% Anaphage
	<u>No Anaphage</u>	-----	<u>No Anaphage</u>	-----
Kg feed/kg body weight gain ¹	3.35	3.40	3.35	3.40
Kg body weight gain/bird ²	3.82	3.82	3.82	3.82
Total feed consumed (kg)	12.80	12.98	12.80	12.98
Feed cost (/kg feed) ³	\$.0881	\$.0866	\$.1374	\$.1359
Feed cost (/bird)	1.128	1.124	1.759	1.764

¹Data from Table 8.

²Data from Table 7.

³Data from Table 13.

DISCUSSION

Since the average body weight gain of growing turkeys (9 to 17 weeks of age) was not significantly ($P \leq .05$) affected by including poultry anaphage in the diet, poultry anaphage could substitute for corn in the diet of growing turkeys. Although, a 30 percent substitution level is questionable because a 0.33 kg per bird average lower weight gain was observed in the birds fed 30 percent poultry anaphage in comparison to the control birds fed no poultry anaphage. Furthermore, the treatment significance level was $P = .061$, and was obviously due to the lower body weight gain in the 30 percent poultry anaphage treatment group (Table 7). This body weight gain data is in agreement with that of Cenni et al. (1969), Flegal and Zindel (1970a), Biely et al. (1972) and Pisone and Begin (1971).

Feed efficiency as shown in Table 8 was inversely related to the level of poultry anaphage incorporated in the diet; that is, the higher the level of anaphage the poorer the feed efficiency. This feed efficiency result is in agreement with that obtained by Flegal and Zindel (1970a, 1970c and 1971) with chicks and laying hens, Biely et al. (1972) with chicks, Durham et al. (1966) with laying hens and Nesheim (1972) with laying hens. However, it is in

opposition to the data of Quisenberry and Bradley (1968) who obtained no adverse effect on feed conversion of laying hens when fed poultry manure in diets calculated to be isonitrogenous and isocaloric to the basal diet which contained no manure. Perhaps the assumed metabolizable energy value was in error since Flegal et al. (1972) reported that the nutrient quality of dehydrated poultry manure was lower the longer the manure was stored prior to dehydration.

In this study poultry anaphage was not of economic value for feeding growing turkeys because the animal fat used to make the diet isocaloric was two to three times more expensive than the corn that was replaced by the poultry anaphage. Perhaps the animal fat could be deleted without influencing feed efficiency as has been observed in studies utilizing 5 to 10 percent poultry anaphage (Hodgetts, 1969; Biely et al., 1972; Flegal and Zindel, 1970b; Flegal and Zindel, 1971).

Perhaps poultry anaphage could be utilized as a protein source; however, a considerable portion of the crude protein of poultry anaphage actually exists in the form of non-protein nitrogen which is assumed to be poorly utilized by chicks. Wehunt et al. (1960) found that utilizing hydrolyzed manure in chick diets sub-optimal in protein improved growth rate; however, the crude protein of the manure was utilized somewhat less efficiently than that of soybean oil meal.

From the economic standpoint, the use of poultry anaphage in turkey rations as a source of unidentified growth

factor may be justified. Wehunt et al. (1960) found that autoclaved manure was nearly equal to fish solubles and dried distillers solubles in corn-soybean oil meal rations containing no other source of unidentified growth factors.

According to Nesheim (1972) poultry anaphage could serve as a source of phosphorous and, thus, could possibly replace the meat and bone meal used in this study.

A significant ($P \leq .05$) effect of dietary poultry anaphage was not observed on plasma uric acid values despite a reported value of 6.3 percent uric acid in dehydrated poultry anaphage by Blair and Knight (1973). Thus, the growing turkey apparently is able to maintain an equilibrium in this regard.

Plasma phosphorous level was significantly ($P \leq .01$) increased by feeding dietary poultry anaphage. The most obvious increase was in the turkeys fed the 30 percent poultry anaphage level. This apparently reflects the phosphorous level of the diet because the 0, 5 and 10 percent poultry anaphage diets had nearly equal calculated phosphorous values (0.84, 0.86 and 0.85 percent, respectively), whereas, the 30 percent poultry anaphage diet had 1.23 calculated phosphorous.

SUMMARY AND CONCLUSIONS

An experiment was conducted to study the effect of feeding dehydrated poultry anaphage on the performance and blood constituents of growing turkeys from 9 to 17 weeks of age.

A significantly ($P \leq .01$) lower 9 to 13 week body weight gain was observed in the turkeys fed the diet that contained 30 percent poultry anaphage. The overall body weight gain from 9 to 17 weeks of age was not significantly ($P \leq .05$) altered by feeding dietary poultry anaphage. However, a numerical decrease of 0.33 kg per bird, in comparison to the control group, was observed in the birds that received 30 percent poultry anaphage in their diet and was significant at $P = .061$.

Feed efficiency was inversely related to the level of anaphage in the diet with conversion figures being 3.35, 3.40, 3.48 and 3.63 kg feed per kg body weight gain for the 0, 5, 10 and 30 percent anaphage diet, respectively. Mortality was not affected by feeding poultry anaphage.

No significant ($P \leq .05$) effect on plasma uric acid levels were observed as a result of feeding poultry anaphage. Plasma phosphorous level was significantly ($P \leq .01$) increased by feeding 30 percent poultry anaphage.

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