Protein and Energy Intake Requirements for Caged Turkey Breeder Hens

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Story in Brief

The nutrient intake requirements of turkey breeder hens have not been determined in research studies under either floor or cage management conditions. Published research data deal almost exclusively with nutrient requirements for turkeys in terms of percent of ration or in units of nutrient per pound of ration. The nutrient requirements for turkeys during both the growing period and laying period, as used under practical feeding conditions, and as recommended by the National Research Council are presented in this way.

There is a need to establish daily protein and energy intake requirements, and to express them as grams of protein and kilocalories of metabolizable energy, respectively. Eventually daily intake requirements must be determined for vitamins and minerals, and these values correlated to the energy intake level which actually will be obtained under a given set of environmental conditions. Otherwise the turkeys will eat to meet their energy requirements, and unless the quantity of feed consumed up to that point contains adequate amounts of all other nutrients, nutritional deficiencies are likely to develop.

In a three-year study involving three individual feeding trials, ration formulating techniques were utilized to provide turkey breeder hens housed in individual laying cages with graded intake levels of protein on an *ad libitum* feeding basis. Actual protein intake levels in these studies ranged from 26 through 39 grams of protein per hen per day. Under the conditions of these three feeding trials, actual energy intake per hen per day averager 346, 351, and 361 kilocalories of metabolizable energy, respectively. There were no statistically significant differences in percent egg production, egg weight, percent fertile eggs, per-

cent hatch of fertile eggs, and percent hatch of all egg set over the range of actual protein intakes which were obtained in the three studies. Body weight changes among the turkey hens were not different statistically regardless of protein intake.

Data from the three-year study summarized in this research report indicate that between 350 and 355 kilocalories of metabolizable energy are required per hen per day. This level of energy intake was obtained in all three studies, and would appear to be a true estimate of the daily energy intake requirement. On the other hand, an intake level of 26 grams of protein per hen per day was equivalent to all other intake levels of protein up to 39 grams per hen per day in supporting reproductive performance. For the time being, an intake level of 26 grams is to be recommended for use under practical feeding conditions. However, it is possible that some reduction in this amount may be possible. In feeding studies now underway, but for which data are not available, ration formulating techniques are being used to control protein intake at levels below 26 grams and to evaluate reproductive performance.

Introduction

The turkey breeder hens used in these studies were small white turkey hens (Mini-hen Line) which weighed between 10 and 12 pounds at the beginning of the test period prior to the onset of lay. It is anticipated that strains of small turkey hens of this type, maintained in laying cages, and bred by means of artificial insemination will become the primary source of turkey hatching eggs in the United States in the foreseeable future. At the present time a management system in which the turkey breeder hens are housed in a caged environment is being used routinely on a wide basis in Europe and the United Kingdom.

Turkey breeders in the United States are currently involved in breeding programs designed to develop improved strains of small white turkeys with potentials for egg production considerably above those inherent in the turkey breeder hens now in use. A caged environment, coupled with the general acceptance and use of these improved egg producing strains of breeder hens should make it possible to substantially reduce poult cost, and bring about a significant saving in the overall cost of producing market turkeys.

Research at Oklahoma State University has been directed toward determining the nutrient intake requirements of turkey breeder hens maintained under this management system. The objective of the three-year study herein reported is to provide basic data upon which intake requirements for energy and protein can be established for use primarily

with caged turkey breeder hens, but also with turkey breeder hens under floor management conditions.

Experimental Procedure

General

The three feeding trials reported in this paper were conducted with the turkey breeder hens housed in individual cages. This arrangement made it possible to obtain individual feed consumption, body weight, and egg production records for each breeder hen, and to consider each individual hen as an experimental unit.

The turkey breeder hens used in these three feeding trials were small broad breasted whites (Mini-hen Line) purchased from River Rest, Incorporated, Shawnee, Oklahoma. The turkey poults (both hens and toms) were obtained when they were day-old and managed as a group under floor brooding and growing conditions until the hens were selected and housed in laying cages at approximately 23 weeks of age. The turkey toms which were to provide semen for artificial insemination were selected at this same time and continued under floor management conditions in individual pens, with from 3 to 5 toms per pen, during the entire breeding period.

A series of starter and grower rations were fed from the time the poults were day-old until each feeding trial was initiated when the turkey hens were approximately 32 weeks of age. The formulating procedure followed, and the nutrient intake standards upon which this series of rations is based were developed through research at Oklahoma State University.

In each of the three feeding trials, the growing period began in June and ended in December when the breeder hens were housed in the laying cages. During this time, natural daylight had progressively decreased to a minimum of 9 hours and 48 minutes. At the time each feeding trial was initiated (January or February), length of daylight for the hens was increased to 14 hours per day. Approximately one month ahead of the time hatching eggs were to be collected, a similar lighting schedule was started with the toms. This lighting regime of 14 hours of daylight each day was maintained with both toms and hens for the duration of each feeding trial.

The schedule of artificial insemination involved one insemination three days before the collection of hatching eggs was initiated, and six others at two-week intervals during the course of the entire hatching egg-collection period which followed. Toward the end of the hatching egg-collection period in all three feeding trials, the interval between in-

seminations was reduced to one week in order to insure a high level of fertility. Semen from two or more toms was pooled and diluted with commercial turkey semen extender before it was used to inseminate the hens.

The experimental breeder rations for all three feeding trials were formulated according to the same procedure that was used with the starter and grower rations. Nutrient intake standards for all nutrients, with the exception of protein and energy, were compiled from nutrient requirement data published by the National Academy of Science in Nutrient Requirements of Poultry. Protein and energy intake levels were selected for feeding trial 1 based upon published data and experience under practical feeding conditions. In feeding trials 2 and 3, the intake level of these nutrients was determined from data obtained in the preceeding trial. Protein intake was controlled by manipulating diet levels of dietary weight, dietary volume, dietary protein, and dietary energy through the use of procedures based upon research data accumulated at Oklahoma State University.

Data were collected on feed consumption, body weight, egg production, fertility, and hatchability at periodic intervals during each feeding trial. In feeding trials 1 and 2 these time intervals were one-week in length with the exception of the time intervals when body weight measurements were made. In feeding trial 1, the breeder hens were weighed at the beginning and at the end of the feeding period; and in feeding trial 2 at the beginning of the trial, at the end of the eighth week, and at the end of the fourteenth week when the feeding trial was terminated. In feeding trial 3, data were collected on feed consumption, body weight, and egg production at four-week intervals; and fertility and hatchability at one-week intervals beginning on the eighth week of the feeding period. Standard management procedures were followed in the care, handling, and incubation of the hatching eggs used in making fertility and hatchability measurements.

Appropriate statistical analyses were made on the data. The following responses were involved in these analyses: feed consumption, protein consumption, energy consumption, percent egg production, egg weight, percent fertile eggs, percent hatch of fertile eggs, and percent hatch of all eggs set.

Feeding Trial 1

Three experimental rations were used in this feeding trial. Graded dietary energy levels of 238, 274, and 310 kilocalories of metabolizable energy were provided in each 100 grams of ration in Rations 1, 2, and 3, respectively. The amount of protein per 100 grams of ration was 19.8,

22.8, and 25.8 grams, respectively. Each ration was fed to 48 individually caged turkey breeder hens.

Feeding Trial 2

Six experimental rations were used in this feeding trial. It was estimated that feed consumption with the type of ration being used would approximate 110 grams per breeder hen per day. In all six experimental rations, 310 kilocalories of metabolizable energy were provided in each 110 grams of ration. Graded dietary protein levels of 22, 24, 26, 28, 30 and 32 grams per 100 grams of ration were included in Rations 1, 2, 3, 4, 5 and 6, respectively. Dietary volume for all rations was approximately 80 milliliters. Each ration was fed to 24 individually caged turkey breeder hens.

Feeding Trial 3

Six experimental rations were used in this feeding trial. Data from feeding trial 2 had indicated that feed consumption was 120 grams per breeder hen per day. In addition, energy consumption averaged 346 kilocalories of metabolizable energy per breeder hen per day. On this basis, the six experimental rations were formulated to provide 335 kilocalories of metabolizable energy in each 120 grams of ration. Graded dietary protein levels of 26, 28, 30, 32, 34, and 36 grams per 120 grams of ration were included in Rations 1, 2, 3, 4, 5, and 6, respectively. Each ration was fed to 24 individually caged turkey breeder hens.

Results and Discussion

Feeding Trial 1

The data on energy consumption and protein consumption for feeding trial 1 are summarized in Table 1. During the first four weeks of the feeding trial (Periods 1-4), statistically significant differences in energy consumption per hen per day were obtained. Apparently the breeder hens were making an adjustment to the experimental rations during these four weeks, and had not equated energy intake to energy requirement. From Period 5 through Period 13, daily energy intake was the same among the breeder hens fed the six experimental rations. Differences in energy intake became evident again during Period 14, which was the last period in the feeding trial.

These data suggest that the turkey breeder hens ate to meet energy intake requirements regardless of dietary energy level. Energy intake averaged 346 kilocalories of metabolizable energy per hen per day. As a

Table 1 Data Feeding Trial 1.

Diet No.	Period No. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Mean
						Energy Consumption[1] (kilocaloriees M.E.)									
1	148	244	268	333	335	321	373	322	380	304	363	312	353	330	339
2	126	254	245	310	340	297	375	330	373	315	368	328	356	357	341
3	179	311	296	354	360	316	388	362	378	324	384	335	367	389	360
*F	2.88	8.70	6.31	4.52	1.69	1.72	0.58	2.06	0.12	0.75	0.95	2.30	0.27	7.46	
**EMS(14)	94.9	57.5	41.8	42.4	40.2	36.7	45.7	85.6	42.8	53.5	52.3	32.5	73.5	46.3	
						Protein Consumption[1] (gm)									
1	12	20	22	28	28	27	31	27	32	25	30	26	30	30	28
2	11	21	20	26	28	25	31	28	31	26	31	27	30	30	29
3	15	26	25	30	30	26	32	30	32	27	32	28	31	33	30
*F	2.89	8.87	6.36	4.57	1.74	1.72	0.61	2.10	0.12	0.77	0.99	2.37	0.29	7.57	
***EMS(14)	6.63	4.01	2.92	2.96	2.81	2.56	3.19	5.98	2.99	3.73	3.65	1.64	5.13	3.23	

*P<.01=6.51, P<.025=4.86, P<.05=3.74, P<.10=2.73,
**1 x 10^3
***1 x 10^8
1. On a per hen per day basis.

result there were statistically significant differences in feed consumption with the feed intake being progressively higher as dietary energy level decreased. Thus the energy intake figure of 346 kilocalories represents a good estimate of energy intake needs.

Statistically significant differences in protein consumption followed the same pattern as was observed for energy consumption. Actual protein intakes were 28, 29, and 30 grams per hen per day for the breeder hens fed Rations 1, 2, and 3, respectively. This range of actual protein intakes was not wide enough to determine protein intake requirements, or to establish a minimum protein intake level.

The data on reproductive performance in terms of percent egg production, egg weight, percent fertile eggs, percent hatch of fertile eggs, and percent hatch of all eggs set are not presented in table form in this paper for feeding trial 1 or for either of the two other feeding trials. However, the data will be summarized in this discussion as reference to it becomes pertinent. An examination of these data indicate that in feeding trial 1 there were no statistically significant differences in any of these response variables due to the experimental ration fed. Body weight change among the breeder hens was essentially the same from ration to ration.

Feeding Trial 2

This feeding trial was designed to provide an estimated energy intake of 310 kilocalories of metabolizable energy per hen per day in all experimental rations. This dietary energy level is somewhat below the average intake of 346 kilocalories of metabolizable energy which was obtained in feeding trial 1. A slightly lower dietary energy level was selected in order to be sure that protein intake would not be controlled at too low a level by energy intake, but at the same time sufficient control would be exercised to provide graded intake levels of protein.

The data on energy consumption and protein consumption for feeding trial 2 are listed in Table 2. As was the case in feeding trial 1, there were no statistically significant differences in the intake level of energy among the breeder hens fed the six experimental rations. Actual energy intake averaged 351 kilocalories of metabolizable energy per hen per day. Adjustment to the rations was made during the first period and energy intake was equivalent within each period during the remainder of the feeding trial. The value of 351 kilocalories of metabolizable energy per hen per day agrees very well with the value of 346 observed in feeding trial 1.

Actual protein intake levels were 26, 31, 32, 34, 36, and 37 grams per hen per day for Rations 1, 2, 3, 4, 5, and 6, respectively. These pro-

Table 2 Data Feeding Trial 2.

Diet No.	Period No. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Mean
						Energy Consumption[1] (kilocaloriees M.E.)									
1	305	275	316	306	334	322	344	329	397	390	346	331	323	348	347
2	298	322	316	324	341	337	405	298	435	386	365	378	370	365	368
3	278	305	303	310	359	349	368	310	357	369	339	354	366	375	355
4	254	274	282	299	336	341	381	316	371	371	290	340	308	400	345
5	267	295	314	318	348	335	380	293	375	370	352	345	351	331	348
6	251	298	275	316	346	343	356	312	379	342	323	322	326	358	341
*F	5.29	.0001	2.29	0.02	0.16	0.53	.001	0.45	3.21	2.16	1.20	0.73	0.20	0.01	
**EMS (35)	3.23	2.39	2.07	1.75	2.21	1.65	2.62	2.41	2.34	4.35	3.93	3.96	5.25	5.72	
						Protein Consumption[1] (gm)									
1	23	21	24	23	25	24	26	25	30	30	26	25	24	26	26
2	26	28	27	28	29	29	35	25	37	33	31	32	32	31	31
3	25	27	27	28	32	31	33	28	32	33	30	32	33	33	32
4	25	27	27	29	33	33	37	31	36	36	28	33	30	39	34
5	28	31	33	33	36	35	40	30	39	38	37	36	37	34	36
6	28	33	30	35	38	38	39	34	41	38	35	35	36	39	37
*F	3.45	23.33	14.06	46.95	46.44	61.33	37.02	24.52	23.13	10.83	11.98	12.35	12.08	14.59	
***EMS (35)	2.79	2.27	1.92	1.36	1.77	1.38	2.16	1.92	2.23	3.73	3.46	3.72	4.49	5.00	

*P<.01=3.61, P<.025=2.97, P<.05=2.49, P<.10=2.03
**1 x 10^2
***1 x 10^1
1. On a per hen per day basis.

tein intake levels ranged upward from the values of 28, 29, and 30 grams of protein intake per hen per day as observed in feeding trial 1. The differences in actual protein intake among the turkey breeder hens fed the six experimental rations were statistically significant within all 14 periods during the feeding trial.

Over the entire range of actual protein intakes, there were no statistically significant differences in terms of percent egg production, egg weight, percent fertile eggs, percent hatch of fertile eggs, percent hatch of all eggs set, and body weight change. Since reproductive performance was no different regardless of protein intake, it can be concluded that a protein intake level of 26 grams per hen per day is equal to intake levels up to 37 grams per hen per day.

Feeding Trial 3

In feeding trial 3, estimated energy intake per hen per day was increased to 335 kilocalories of metabolizable energy in an attempt to control protein intake at levels below 26 grams of protein per hen per day. The data for energy consumption and protein consumption are presented in Table 3 for feeding trial 3. They show that actual energy consumption averaged 361 kilocalories of metabolizable energy per hen per day which is slightly higher than that observed in the previous two feeding trials.

Actual protein consumption was 28, 30, 29, 37, 39, and 37 for Rations 1, 2, 3, 4, 5, and 6, respectively. Here again as in feeding trial 2, the protein intake levels range upward from 26 or 28 grams per hen per day to 39 grams. It would appear that actual energy intake per hen per day may have been increased by the hens in order to bring actual protein intake up to a minimum of 28 grams per hen per day. Whether this is the actual situation remains to be determined in a feeding trial now underway.

Data on reproductive performance for feeding trial 3 show no statistically significant differences due to the actual protein intakes which were obtained. These results agree with those observed with a similar range of protein intakes in feeding trial 2.

Conclusions and Recommendations

The data from these three feeding trials indicate that breeder hens eat to meet a very definite daily energy intake requirement. Under the conditions of these experiments, this intake requirement approximated 350 to 355 kilocalories of metabolizable energy per hen per day. At environmental temperatures above or below the 50°F to 60°F average

Table 3. Data Feeding Trial 3

Diet No.	Period No. 1	2	3	4	5	Mean
			Energy Consumption[1] (kilocalories M.E.)			
1	247	262	375	371	360	369
2	242	241	352	379	342	358
3	237	238	342	326	318	329
4	243	253	432	389	364	395
5	233	261	340	406	371	372
6	245	235	326	342	344	337
*F	0.44	0.40	3.43	1.11	1.03	
EMS(35)	494.1	2170.3	3415.9	6360.5	2906.3	
			Protein Consumption[1] (gm)			
1	19	20	29	29	28	28
2	20	20	29	31	28	30
3	21	21	30	29	28	29
4	23	24	41	37	34	37
5	25	26	36	43	39	39
6	27	26	36	37	38	37
*F	16.24	3.64	6.27	4.53	8.60	
EMS(35)	4.314	17.93	29.46	55.22	24.55	

*$P<.01=3.61$, $P<.025=2.97$, $P<.05=2.49$, $P<.10=2.03$
1. On a per hen per day basis.

maintained in these feeding trials, the energy intake requirement will decrease or increase, respectively. This fact should be taken into consideration in establishing energy intake standards for use under a variety or practical feeding conditions. In addition, the dietary levels of all other nutrients should be related to the actual energy intake which it is anticipated will be obtained. This must be done to insure an adequate intake of all other nutrients when the energy intake requirement has been met and the turkey breeder hen stops consuming feed.

The data on actual protein intake from these three feeding trials support the conslusion that a protein intake level of 26 grams per hen per day is equal to daily intake levels up to 39 grams. With the energy to protein ratios used in feeding trials 2 and 3, protein intake per hen per day seemed to reach a minimum level of 26 or 28 grams regardless of the dietary protein level used. In fact, there is some evidence to indicate that actual daily energy intake per hen may have exceeded a daily energy intake level of 350 to 355 kilocalories in order for this daily protein intake level to be reached. Thus 26 grams of protein per hen per day may be the minimum required. However, this possibility will have

to be investigated further with rations designed to control protein intake at levels below 26 grams per hen per day.

In the formulation of turkey breeder rations for use under practical feeding conditions, full consideration must be given to the dietary-energy to dietary-protein ratio, and estimated daily feed consumption. Care must be exercised to be sure that protein intake approximates 26 grams when the energy intake requirement has been met. Protein intake levels above 26 to 28 grams per hen per day are excessive, and add to ingredient cost without being justified from a nutritional standpoint. To minimize protein intake, advantage should be taken of the nutrient intake control provided by energy intake. In all cases, daily energy intake and daily protein intake requirements must be included in that quantity of ration that it is physically possible for a turkey breeder hen to consume in one day.
