PROTEIN AND ENERGY INTAKE

REQUIREMENTS FOR CAGED

TURKEY BREEDER HENS

By

CARL DEAN JACKSON
//
Bachelor of Science

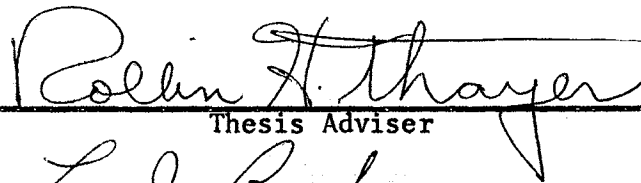Oklahoma State University

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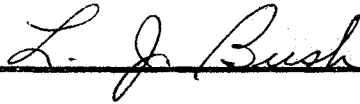for the Degree of
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TURKEY BREEDER HENS

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CHAPTER I

INTRODUCTION

The high cost of the day-old turkey poult is one of the most seri-
ous economic problems facing the commercial turkey producer. Under
normal conditions, poult cost represents approximately 20 percent of
the total production cost of market and breeder turkeys, a substantial
reduction here would result in an immediate reduction in overall pro-
duction cost and increased profit margins.

In order to lower the cost of day-old poults, turkey breeders
are in the process of developing turkey breeder hens with a high
potential for egg production and are utilizing a management system
that is in use at the present time in Europe and South America. This
innovation in management systems for turkey breeders is the housing
of turkey breeder hens in laying cages. The turkey hens developed
for the cage environment are relatively small (6 to 12 pounds) and
bred to lay 120 to 150 eggs per hen per year with no loss in egg size.
Small body size makes it possible for these hens to be more efficient
in the conversion of feed into eggs than those turkey breeder hens
which have been used in the past. Artificial insemination is used to
produce fertile hatching eggs. The breeder toms used to produce semen
average between 35 and 45 pounds each, and contribute body size as
well as other market characteristics which are present to only a
moderate degree in the breeder hen line(s).

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Difficulties have been encountered in the housing of turkey breeder hens in laying cages. One of the problems is to provide the proper nutrient intake for the turkey breeder hens so that their full genetic potential for egg production will be expressed. Very little data are available on the role of dietary nutrients in determining feed and nutrient intake of turkey breeder hens when housed in a cage environment. Until the nutrient intake requirements are established, it will be difficult to formulate turkey breeder rations for optimum egg production and hatchability for the breeder hens maintained in cages.

The objectives of this experiment were to determine the effects of graded levels of dietary protein on feed and energy intake, and the subsequent effects upon egg production, egg weight, body weight changes, and reproductive performance.

CHAPTER II

REVIEW OF LITERATURE

Only a limited amount of data has been reported in the literature
pertaining to the nutrient intake requirements of turkey breeder hens,
or the effect of dietary energy (kilocalories of metabolizable energy
per hen per day) on feed consumption and nutrient intake. This is
true of turkey breeder hens maintained either on the floor or in lay-
ing cages. Current data on feed consumption, protein and energy
requirements, and the effect of deitary protein and dietary energy on
feed consumption and nutrient intakes are summarized in the following
discussion.

Feed Consumption

Wolford et al. (1962) worked with Broad Breasted Bronze hens
housed in individual laying cages and stated that during the experi-
ment the hens consumed an average of 220 grams of feed per hen per day.
In another experiment, Wolford et al. (1963) reported an average daily
feed intake of 252 grams per hen for the Broad Breasted Bronze hens,
and 137 grams per hen per day for the Beltsville Small White hens.

Holder (1970) conducted a feeding trial with medium size turkey
breeder hens and reported 211.7 grams per hen per day as the average
daily feed intake for hens in individual laying cages. Burrus (1972),
in a feeding trial with small white turkey breeder hens, reported

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that during this trial, average daily feed intake for hens in individual laying cages was 118.4 grams per hen per day. Jackson et al. (1974) discussed a 1972 feeding trial which showed an average daily feed intake of 120 grams per hen for small white turkey hens housed in individual laying cages.

Protein and Energy Levels

Robblee and Clandinin (1959) reported the results of an experiment which utilized two levels of protein and three levels of energy. The protein levels were 15 and 17 percent; the energy levels were 1540, 1740, and 1940 kilocalories of productive energy per kilogram of diet. With these variables, they found no differences in egg production, fertility, hatchability, number of poults, daily feed consumption, or final market grade of the hens. They observed no effect of dietary energy upon feed intake.

Jensen and McGinnis (1961) reported on the quantitative requirement of turkey breeder hens for protein. In their first two experiments, levels of protein from 15 to 20 percent were utilized and no differences in performance were observed. They, therefore, explored lower protein levels in a third experiment. Using protein levels of 10, 12, 14, and 16 percent, they found that birds which received the 10 percent level of protein performed as well as birds which received the higher levels during an experimental period of 11 weeks. These workers suggested that the 15 percent protein level recommended by the National Research Council at that time was more than adequate.

Atkinson et al. (1960) fed turkey breeder hens protein levels of 16, 19, 22, and 25 percent. The highest rate of egg production and

feed efficiency was observed on the ration which contained 22 percent protein. Protein level did not affect fertility or hatchability. In other work, Atkinson et al. (1970) fed rations which contained 12, 15, 18, or 21 percent protein to Beltsville Small White and Broad Breasted White hens. They found that the best feed efficiency was at the 15 percent protein level, and that the 12 percent protein level was not sufficient to support both body weight and egg production. This group concluded that both large and small hens require a minimum of 15 percent protein for normal reproductive performance under normal conditions.

Bradley et al. (1969) reported results of a study where Broad Breasted White hens in cages and Beltsville Small White hens in floor pens were fed diets of 12, 15, 18, and 21 percent protein. It was concluded that the large and small turkey hens required at least 18 percent and 15 percent protein, respectively, for normal reproductive performance. Bradley et al. (1971) fed Broad Breasted White hens rations which contained 12, 15, or 18 percent protein levels and Beltsville Small White hens rations which contained 15 or 18 percent protein levels. Through 7 weeks of production, these researchers found that the highest rate of production for both the Broad Breasted Whites and the Beltsville Small Whites was at the 15 percent protein level. In another experiment, Bradley et al. (1972) fed Beltsville Small White hens a practical-type turkey breeder diet which contained either 15 or 18 percent protein. Through 8 weeks of production the birds which received the 18 percent protein ration produced 5 percent more eggs than those fed the 15 percent protein ration. Body weight and egg size followed the same general trend as egg production. These

research workers also found that both fertility and hatchability were improved by the 18 percent protein diet.

In a study of off-season egg production of turkeys, Touchburn (1968) found that the regular ration (17.3 percent protein, 2860 kilocalories of metabolizable energy per kilogram) performed as well as a similar diet of higher protein and less energy (19.5 percent protein, 2783 kilocalories of metabolizable energy per kilogram). In data from a large field experiment in Texas, Wahid et al. (1967) reported overall superior performance with turkey breeder hens which received 21 percent protein as compared to hens which received 19, 23, and 25 percent protein. The birds fed 19 percent protein produced fewer eggs and were not able to maintain body weight as effectively as those fed the higher protein levels. This study was conducted from August 1 to December 17. Krueger (1969) reported on some summer work with Broad Breasted Bronze and Broad Breasted White turkeys in which he compared protein levels of 21.7 percent and 24.7 percent to productive energy levels of 1914 and 1988 kilocalories per kilogram of feed. Krueger suggested that a 21 to 22 percent protein level with relatively low energy levels should be adequate during periods of hot weather.

Carter et al. (1957) compared rations of 16 and 18 percent protein levels in combination with 1760, 1980, and 2200 kilocalories of productive energy per kilogram. Fertility and hatchability were slightly in favor of the 18 percent protein level. Anderson (1964) used Jersey Buff and Broad Breasted White turkey females and found that increasing the metabolizable energy content of turkey breeder diets which contained 14.5 or 16.5 percent protein combined with 158 kilocalories of metabolizable energy per kilogram (addition of 4 percent animal fat)

had no effect on fertility or hatchability with either strain. With the Jersey Buff hens, egg production was identical regardless of protein or energy level. With the large-type White hens, egg production was somewhat depressed at the 14.5 percent protein level as compared to the 16.5 percent protein level, but only when animal fat was not added to the diet.

Holder (1970) fed diets which contained combinations of two energy levels and three calorie to protein ratios. The levels of energy used were 281.25 and 312.50 kilocalories of metabolizable energy per 100 grams of diet. The calorie to protein ratios used were 15, 17, and 19 kilocalories per gram of protein. The hens (medium size) tended to consume approximately 600 kilocalories of metabolizable energy per hen per day regardless of energy level or calorie to protein ratio.

Burrus (1972) fed three experimental diets which contained three energy levels and one calorie to protein ratio. The three levels of energy used were 238, 274, and 310 kilocalories of metabolizable energy per 100 grams of diet with a calorie to protein ratio of 12.0 kilocalories of metabolizable energy per gram of protein. The hens (Small Whites) consumed approximately 321 kilocalories of metabolizable energy per hen per day. Energy level had no effect on energy consumption, but did affect feed consumption.

Jackson et al. (1974) discussed a 1972 feeding trial designed to provide an estimated energy intake of 310 kilocalories of metabolizable energy per hen per day with an average feed intake of 110 grams per hen per day. Six rations which provided graded dietary protein levels of 22, 24, 26, 28, 30, and 32 grams per 110 grams of ration, were used. Actual energy intake averaged 351 kilocalories of metabolizable energy

per hen per day. There were no statistically significant differences in reproductive performance.

Amino Acid Supplementation

Owings (1963) worked with Broad Breasted Bronze hens and fed a 15 percent protein diet (0.68 percent lysine) with added lysine at 0.0, 0.2, 0.4, and 0.6 percent levels. Fertility and hatchability were improved while egg production and weight loss pattern remained the same. In three experiments with large-type turkey hens, Minear et al. (1972) found that no statistically significant improvements in reproductive performance were obtained from increasing protein in the diet from 14 to 16 or 18 percent or from adding lysine to the 14 percent protein diet.

Milligan et al. (1963) worked with Maryland Medium White turkeys in cages. The hens were fed rations that contained 12, 15, and 18 percent protein levels. A 12 percent protein level supplemented with methionine was also fed and the data indicated that this ration produced the most eggs with the best feed efficiency during the four-month period of lay.

Luther and Waldroup (1970) conducted studies to determine the needs of turkey breeder hens for protein and/or methionine. The caged turkey hens (Broad Breasted Whites) were fed diets which contained 2640 or 2900 kilocalories of metabolizable energy per kilogram. The diets were formulated without protein restrictions and contained 14.7 percent protein (0.45 percent total sulphur amino acids), and 16.0 percent protein (0.46 percent total sulphur amino acids). Dl-methionine was added at levels up to 0.66 percent total sulphur amino acids.

When compared to an 18 percent protein diet, there was no differences in reproductive performance between any of the experimental diets.

Atkinson (1972) fed 15 and 18 percent protein diets with a single grain source of corn or milo to Beltsville Small White turkeys. His results showed that supplementation with lysine and methionine improved the 18 percent protein ration regardless of grain source, but that the same supplementation at a 15 percent protein level only improved the milo-containing ration. His work showed the 18 percent protein ration to be optimum for the Beltsville Small White hens.

Summary

All of the previous research with both caged and floor pen management programs presents protein as a percent of the total ration with a conflict in the results obtained by different research workers as to the minimum amount of protein necessary in the diet. In view of these observations, this experiment was conducted in an effort to establish with more precision the quantitative needs of the caged turkey breeder hen on a per hen per day basis.

CHAPTER III

EXPERIMENTAL PROCEDURES AND METHODS

General Procedures

This experiment consisted of two feeding trials conducted in the Turkey Cage Laboratory on the Oklahoma State University Poultry Farm. The laboratory contains 144 individual wire cages which are arranged in four rows with thirty-six cages per row. Each cage is sixteen inches wide, thirty inches long, and thirty inches tall, and is equipped with automatic waterer, feeder, and feed storage container. The individual feed storage containers make it possible to weigh the feed separately for each hen, and permit the individual hen to be considered an experimental unit.

The building is equipped with four forced-air ventilators and four gas stoves for temperature and ventilation control. The laboratory is supplied with artificial light by incandescent lamps which are controlled by automatic time clocks.

The first feeding trial began on December 27, 1972, and ran through May 15, 1973. The turkey breeder hens were thirty-two weeks old at the start of the experiment and fifty-two weeks old at its termination. The second feeding trial began on February 1, 1974, and ran through June 20, 1974. The turkey breeder hens used in this feeding trial were thirty-five weeks old at the start and fifty-five weeks old at its termination. The turkeys used in these feeding trials were

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small whites (mini-hen line) produced by River Rest Farms, Incorporated
of Shawnee, Oklahoma.

The turkeys were raised on the Oklahoma State University Poultry
Farm and were started in battery brooders. At one week of age they
were transferred to floor pens. At twenty-nine weeks of age, 144
breeder hens were randomly selected, transferred into the turkey cage
laboratory and placed in individual wire cages. The males used to pro-
vide semen for artificial insemination remained in the floor pens until
the experiment was terminated. All turkeys were fed the same diet
until thirty weeks of age, at which time the hens were transferred to
a low protein diet (Table I) to retard egg production.

Lighting Schedule

Starting at thirty-two weeks of age the breeder toms were given
fourteen hours of continuous light, and ten hours of continuous dark-
ness. The breeder hens were placed on this same lighting schedule at
thirty-four weeks of age during the first feeding trial, and at thirty-
five weeks of age during the second trial. Both hens and toms were on
this lighting schedule for the remainder of each feeding trial.

Artificial Insemination

In Trial One, the hens were first artificially inseminated at
thirty-nine weeks of age; again at forty weeks of age and every two
weeks thereafter. In Trial Two, the hens were first artificially
inseminated at thirty-eight weeks; again at thirty-nine weeks and
every two weeks thereafter. Before it was used to inseminate the hens,
semen from two or more toms was pooled and diluted with a commercial

TABLE I

TURKEY HOLDING RATION

H-1436

December, 1973

Ingredients	Percent
Corn	27.0
Milo	48.5
Alfalfa meal	6.5
Live yeast culture[1]	4.0
Oats	4.0
Cotton seed meal	2.0
Soybean meal	5.0
Dicalcium phosphate[2]	2.0
VMC-60[3]	0.5
Salt	0.5
	100.0

[1]Manufactured by Diamond V. Mills, Cedar Rapids, Iowa.

[2]Calcium = 27%; Phosphorus = 20%.

[3]Supplies per kilogram of finished ration: vitamin A, 17,600 I.U.; vitamin D_3, 2640 I.U.; vitamin E, 13.2 I.U.; vitamin K, 6.6 mg.; vitamin B_{12}, 0.018 mg.; riboflavin, 8.8 mg.; niacin, 70.4 mg.; panthothenic acid, 17.6 mg.; choline chloride, 110 mg.; manganese, 60.94 mg.; iodine, 1.89 mg.; cobalt, 1.30 mg.; iron, 47.96 mg.; copper, 3.63 mg.; zinc, 49.94 mg.

turkey semen extender produced by the Minnesota Turkey Growers Associa-
tion.

Collecting, Storage and Incubation of Eggs

Daily, eggs were collected, weighed, fumigated and taken to the
egg storage room in the Poultry Science Building on the Oklahoma State
University Campus. The eggs were held until the end of each seven-day
period. They were then set in Jamesway incubators and fumigated again.
Eggs were candled and fertile eggs transferred to hatching trays at
twenty-four days of incubation. The eggs which appeared clear were
not transferred, but were broken out and checked for early embryonic
mortality. Percent egg production was based upon the average number
of eggs laid per hen in a 28 day period.

Experimental Diets

Six experimental diets were fed during each trial, with each diet
being fed to twenty-four breeder hens. Treatments were randomly
assigned to the birds so that there would be three per diet for each of
the eight blocks. Treatment arrangements are shown in Tables II and
III. The diets included six protein levels and one energy level. Com-
position of the six diets used in each study is shown in Tables IV and
V.

In Feeding Trial One, the six graded dietary levels of protein
used were 26, 28, 30, 32, 34, and 36 grams of dietary protein per 120
grams of diet for Rations 1, 2, 3, 4, 5, and 6, respectively. The six
experimental rations were formulated to provide 335 kilocalories of
metabolizable energy in each 120 grams of ration. The six levels of

TABLE II

CAGE ASSIGNMENTS OF TREATMENTS IN TURKEY CAGE LAB - 73

EAST

Block 1 / Block 4

Diet No.	Cage No.	Diet No.	Cage No.
6	301	3	372
1	302	2	371
1	303	3	370
6	304	3	369
5	305	5	368
3	306	1	367
5	307	1	366
2	308	4	365
3	309	1	364
2	310	2	363
4	311	4	362
4	312	5	361
4	313	6	360
6	314	6	359
2	315	2	358
1	316	4	357
5	317	5	356
3	318	6	355

Block 2 / Block 3

Diet No.	Cage No.	Diet No.	Cage No.
3	319	4	354
2	320	5	353
4	321	4	352
1	322	6	351
5	323	3	350
4	324	2	349
5	325	1	348
5	326	6	347
2	327	5	346
3	328	6	345
1	329	4	344
4	330	2	343
3	331	5	342
1	332	1	341
6	333	3	340
6	334	3	339
2	335	1	338
6	336	2	337

Block 5 / Block 8

Diet No.	Cage No.	Diet No.	Cage No.
4	373	4	444
3	374	3	443
6	375	5	442
2	376	1	441
3	377	2	440
2	378	2	439
6	379	3	438
2	380	5	437
1	381	3	436
4	382	4	435
5	383	4	434
1	384	6	433
4	385	6	432
5	386	5	431
6	387	6	430
3	388	2	429
5	389	1	428
1	390	1	427

Block 6 / Block 7

Diet No.	Cage No.	Diet No.	Cage No.
4	391	5	426
5	392	6	425
4	393	4	424
6	394	2	423
5	395	1	422
6	396	3	421
3	397	4	420
2	398	5	419
1	399	2	418
5	400	3	417
1	401	1	416
4	402	2	415
1	403	6	414
3	404	1	413
2	405	3	412
6	406	4	411
3	407	5	410
2	408	6	409

NORTH

SOUTH

WEST

TABLE III

CAGE ASSIGNMENTS OF TREATMENTS IN TURKEY CAGE LAB = 74

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NORTH

Block 2   **Block 1**

	Block 2 (Cage 319–336)																	Block 1 (Cage 301–318)																	
Diet No.	1	5	3	6	5	4	1	5	4	1	2	6	2	3	2	6	3	2	4	5	4	6	3	2	1	6	3	5	5	1	3	3	1	3	1	2
Cage No.	336	335	334	333	332	331	330	329	328	327	326	325	324	323	322	321	320	319	318	317	316	315	314	313	312	311	310	309	308	307	306	305	304	303	302	301
Diet No.	5	6	4	2	1	3	4	5	2	3	1	2	6	1	3	4	5	6	6	3	5	2	2	5	3	5	4	3	4	6	6	5	2	1	1	1
Cage No.	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372

Block 3   **Block 4**

WEST · EAST

Block 6   **Block 5**

	Block 6 (Cage 391–408)																	Block 5 (Cage 373–390)																	
Diet No.	3	2	3	3	5	1	1	4	1	2	4	5	6	6	5	4	5	6	2	3	6	2	6	5	1	3	4	1	5	4	6	5	4	5	2	3
Cage No.	408	407	406	405	404	403	402	401	400	399	398	397	396	395	394	393	392	391	390	389	388	387	386	385	384	383	382	381	380	379	378	377	376	375	374	373
Diet No.	3	5	2	1	6	4	4	4	2	3	2	5	4	5	6	1	1	6	6	2	6	1	3	4	1	3	5	3	2	5	4	5	4	2	3	3
Cage No.	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444

Block 7   **Block 8**

SOUTH

TABLE IV

PERCENTAGE COMPOSITION OF EXPERIMENTAL DIETS - 73

	Diet					
	1	2	3	4	5	6
Gms. protein per 120 gms. diet	18	20	22	24	26	28
Ingredients						
Tallow	0.52	1.60	2.68	3.76	4.84	5.93
Ground yellow corn	54.72	49.32	43.90	38.48	33.06	27.64
Soybean oil meal (44%)	20.22	22.75	25.29	27.83	30.36	32.90
Fish meal (50%)	8.09	9.10	10.12	11.13	12.15	13.16
Meat and bone scrap (50%)	4.04	4.55	5.06	5.56	6.07	6.58
Blood meal	2.02	2.27	2.53	2.78	3.04	3.29
Live yeast culture[1]	0.81	0.91	1.01	1.11	1.21	1.31
Whey, dried	0.81	0.91	1.01	1.11	1.21	1.31
Alfalfa meal (17%)	0.81	0.91	1.01	1.11	1.21	1.31
Dicalcium phosphate[2]	2.56	2.30	2.04	1.78	1.52	1.26
Calcium carbonate	4.36	4.34	4.31	4.29	4.27	4.25
Salt	0.50	0.50	0.50	0.50	0.50	0.50
VMC-60[3]	0.50	0.50	0.50	0.50	0.50	0.50
dl-Methionine	0.04	0.04	0.04	0.06	0.06	0.06
Total	100.00	100.00	100.00	100.00	100.00	100.00

[1]Manufactured by Diamon V. Mills, Cedar Rapids, Iowa.

[2]Calcium = 27%; Phosphorus = 20%.

[3]Supplies per kilogram of finished ration: vitamin A, 17,600 I.U.; vitamin D_3, 2640 I.U.; vitamin E, 13.2 I.U.; vitamin K, 6.6 mg.; vitamin B_{12}, 0.018 mg.; riboflavin, 8.8 mg.; niacin, 70.4 mg.; panthothenic acid, 17.6 mg.; choline chloride, 110 mg.; manganese, 60.94 mg.; iodine, 1.89 mg.; cobalt, 1.30 mg.; iron, 47.96 mg.; copper, 3.63 mg.; zinc, 49.94 mg.

TABLE V

PERCENTAGE COMPOSITION OF EXPERIMENTAL DIETS - 74

	Diet					
	1	2	3	4	5	6
Gms. protein per 120 gms. diet	18	20	22	24	26	28
Ingredients						
Tallow	8.13	8.53	8.89	9.36	9.93	10.56
Ground yellow corn (12%)	58.98	55.26	51.46	47.40	43.12	38.63
Soybean oil meal (43.43%)	9.14	11.47	13.90	16.35	18.84	21.36
Fish meal (60.04%)	3.66	4.58	5.56	6.54	7.53	8.54
Meat and bone scrap (45.95%)	1.82	2.29	2.77	3.27	3.76	4.27
Blood meal (89.91%)	0.91	1.14	1.38	1.63	1.88	2.15
Live yeast culture (13.24%)[1]	0.36	0.45	0.55	0.65	0.75	0.85
Whey, dried (14.24%)	0.36	0.45	0.55	0.65	0.75	0.85
Alfalfa meal (18.63%)	0.36	0.45	0.55	0.65	0.75	0.85
Dicalcium phosphate[2]	3.53	1.99	1.72	1.45	1.18	0.91
Calcium carbonate	5.05	5.99	5.95	5.90	5.85	5.80
Salt	0.50	0.50	0.50	0.50	0.50	0.50
VMC-60[3]	0.50	0.50	0.50	0.50	0.50	0.50
Sand	6.65	6.35	5.67	5.10	4.60	4.17
Dl-Methionine	0.05	0.05	0.05	0.05	0.06	0.06
Total	100.00	100.00	100.00	100.00	100.00	100.00

[1]Manufactured by Diamond V. Mills, Cedar Rapids, Iowa.

[2]Calcium = 27%; Phosphorus = 20%.

[3]Supplies per kilogram of finished ration: vitamin A, 17,600 I.U.; vitamin D_3, 2640 I.U.; vitamin E, 13.2 I.U.; vitamin K, 6.6 mg.; vitamin B_{12}, 0.018 mg.; riboflavin, 8.8 mg.; niacin, 70.4 mg.; panthothenic acid, 17.6 mg.; choline chloride, 110 mg.; manganese, 60.94 mg.; iodine, 1.89 mg.; cobalt, 1.30 mg.; iron, 47.96 mg.; copper, 3.63 mg.; zinc, 49.94 mg.

protein used for Feeding Trial Two were 18, 20, 22, 24, 26, and 28 grams of dietary protein per 120 grams of diet for Rations 1, 2, 3, 4, 5, and 6, respectively. Each ration was formulated to provide 360 kilocalories of metabolizable energy in each 120 grams of ration.

Data Collection and Statistical Analysis

Each of the two feeding trials was divided into five periods. Each period was twenty-eight days in length. Individual feed consumption and body weight data were collected at the end of each period. Egg production was recorded daily, and all eggs were weighed individually. A record of fertile eggs and poults hatched for each individual hen for each period was kept.

The data were analyzed as a randomized block design having six treatments in each block. There were eight blocks. The unweighted average of $1 \leq N_{ij} \leq 3$ in each treatment block combination was used as the experimental unit. The calculations were made on an IBM 360, Model 65, using a statistical analysis system (SAS) developed at North Carolina State University, under regional project S94. The following responses were involved in the analyses: feed consumption, protein consumption, energy consumption, body weight change, egg production (number of eggs laid, average egg weight, percent egg production), and reproduction performance (percent fertile eggs, hatch of eggs set, hatch of fertile eggs, poults hatched).

CHAPTER IV

RESULTS AND DISCUSSION

Feed Consumption

In Feeding Trial One, the overall mean for feed consumption was
112.3 grams per hen per day. The overall mean for Feeding Trial Two
was 111.0 grams per hen per day. The feed consumption mean values by
period are presented for each treatment in Tables VI and VII. The
average feed consumption is in close agreement with Burrus (1972), and
Jackson et al. (1974).

By the beginning of Period Three the turkey breeder hens will
have established their energy requirement and will be eating to meet
this requirement. A mean calculated from Periods Three, Four, and
Five might be a better estimate of daily feed intake under the condi-
tions of these feeding trials than an overall mean. Such means would
be 128.9 and 120.9 grams per hen per day for Feeding Trial One and
Two, respectively. The mean for Feeding Trial Two would be expected
to be lower than Feeding Trial One because of the higher energy den-
sity of the rations used in the second feeding trial.

A statistical analysis of the feed consumption data shows that,
with the exception of period three of Feeding Trial One, treatments
had no significant effect on feed consumption, (Tables VIII and IX).
It is not known why in Period Three there was a statistically signifi-
cant difference in feed consumption among treatments $(P < .05)$, but it

TABLE VI

FEED CONSUMPTION

FEEDING TRIAL ONE

Diet No.	Period Number				
	1	2	3	4	5
	(Grams of feed per bird per day)				
1	88	94	134	133	129
2	87	86	126	136	122
3	85	85	122	117	114
4	87	91	155	139	130
5	84	90	122	146	133
6	88	84	117	123	123
F	0.44	0.40	3.43*	1.11	1.03
EMS (df = 35)	63.5	278.9	439.0	817.4	375.5

*Significant at .05 level of probability.

TABLE VII

FEED CONSUMPTION

FEEDING TRIAL TWO

Diet No.	Period Number				
	1	2	3	4	5
	(Grams of feed per bird per day)				
1	84	110	123	132	119
2	80	112	120	116	118
3	85	107	121	118	121
4	87	101	110	118	128
5	85	107	122	124	124
6	85	110	121	115	127
F	0.34	1.16	0.95	1.16	0.37
EMS (df = 35)	113.7	102.2	207.0	283.4	409.6

is possible that the difference was due to an error in weighing the feed. Feed was added during this period. If a mistake was made in the addition of feed, the error would only be seen in Period Three as all the feed was weighed again at the end of the period.

Energy Consumption

The means for average daily energy consumption are presented by periods in Tables X and XI. The overall means for energy consumption were 313.5 and 333.0 kilocalories of metabolizable energy per hen per day for Feeding Trials One and Two, respectively. Perhaps a more realistic look at the energy requirement of these turkey breeder hens would be a comparison of Periods Three, Four, and Five. By the start of Period Three the energy consumption would be stabilized and an average of the three periods for each treatment should provide a good estimate of the energy requirement for the birds on the treatment. The means for these three periods were 360 and 362.8 kilocalories of metabolizable energy per hen per day for Feeding Trials One and Two, respectively.

With the exception of period three of Feeding Trial One, there were no significant differences in energy consumption due to treatment (Tables XII and XIII). Since energy consumption is computed from feed consumption, the difference among treatments in feed consumption for Period Three caused the difference among treatments in energy consumption for the same period.

No significant difference among treatments was expected as the diets fed within each feeding trial were isocaloric and as energy content of a diet has been shown to be an intake regulator for turkey

TABLE X

ENERGY CONSUMPTION

FEEDING TRIAL ONE

Diet No.	Period Number				
	1	2	3	4	5
	(Kilocalories of metabolizable energy per hen per day)				
1	247	262	375	371	360
2	242	241	352	379	342
3	237	238	342	326	318
4	243	253	432	389	364
5	233	251	340	406	371
6	245	235	326	342	344
F	0.44	0.40	3.43*	1.11	1.03
EMS (df = 35)	494.1	2170.3	3415.9	6360.5	2906.3

*Significant at .05 level of probability.

TABLE XI

ENERGY CONSUMPTION

FEEDING TRIAL TWO

Diet No.	Period Number				
	1	2	3	4	5
	(Kilocalories of metabolizable energy per hen per day)				
1	253	331	370	396	356
2	241	335	359	348	353
3	255	322	362	354	364
4	261	303	329	355	385
5	256	320	366	372	371
6	255	329	364	345	381
F	0.34	1.16	0.95	1.16	0.37
EMS (df = 35)	1023.59	920.00	1862.98	2550.20	3686.44

breeder hens. This points out the need for an accurate estimate of energy to nutrient ratios in the formulation of turkey diets for all types of turkeys.

Protein Consumption

Since turkey breeder hens do tend to eat to meet their energy requirements, there were significant differences (P<.01) in protein consumption due to treatment for all periods in both feeding trials (Tables XIV and XV). The protein consumption mean values are presented by period for each treatment in Tables XVI and XVII for Feeding Trials One and Two, respectively.

Actual dietary protein consumption for Feeding Trial One was 27.7, 29.7, 31.9, 34.0, 37.8, and 39.4 grams per 128.9 grams of feed for Rations 1, 2, 3, 4, 5, and 6, respectively. The figures shown above represent a mean value for each treatment for Periods Three, Four, and Five; and are based on actual feed consumption for those periods. Similar means were calculated for Periods Three, Four, and Five of Feeding Trial Two. In this feeding trial, actual dietary protein consumption was 16.5, 17.9, 20.2, 23.2, 25.1, and 26.9 grams per 120.9 grams of feed for Rations 1, 2, 3, 4, 5, and 6, respectively. The protein consumption figures for both feeding trials represent a mean value for each treatment group in grams of protein consumed per hen per day.

Body Weight Change

Turkey breeder hens will draw from their body reserves to meet their egg production needs if the diet is not adequate. Turkey breeder

TABLE XVI

PROTEIN CONSUMPTION

FEEDING TRIAL ONE

Diet No.	Period Number				
	1	2	3	4	5
	(Grams of protein per hen per day)				
1	19.0	20.2	28.8	28.5	27.7
2	20.0	19.9	29.1	31.4	28.2
3	21.0	21.1	30.3	28.9	28.2
4	23.0	23.9	40.9	36.8	34.4
5	24.5	26.4	35.7	42.6	38.9
6	26.9	25.7	35.7	37.4	37.6
F	16.24**	3.64**	6.27**	4.53**	8.60**
EMS (df = 35)	4.314	17.93	29.46	55.22	24.55

**Significant at .01 level of probability.

TABLE XVII

PROTEIN CONSUMPTION

FEEDING TRIAL TWO

Diet No.	Period Number				
	1	2	3	4	5
	(Grams of protein per hen per day)				
1	11.5	15.1	16.9	18.0	16.2
2	11.9	16.5	17.7	17.2	17.4
3	14.2	17.9	20.1	19.7	20.2
4	16.7	19.3	21.0	22.7	24.6
5	17.8	22.1	25.4	25.8	25.7
6	18.9	24.4	27.0	25.6	28.2
F	23.38**	28.69**	17.55**	10.98**	13.80**
EMS (DF = 35)	3.298	3.423	7.617	10.283	13.583

**Significant at .01 level of probability.

hens would be expected to show some weight loss on any ration when in heavy production. Tables XVIII and XIX show the average body weight change by period for Feeding Trials One and Two, respectively. With the exception of Period 5 in Feeding Trial One, there were no statistically significant differences among treatments (Tables XX and XXI).

Lower energy density rations were used in Feeding Trial One (335 kilocalories of metabolizable energy in each 120 grams of ration). With the onset of heavy egg production, a consistent weight loss was noted for all treatments in Periods 2, 3, and 4 of this feeding trial. Substantial weight loss would be expected with the initial phase of egg production, but the turkey breeder hen would normally increase feed consumption to meet the additional protein and energy requirements. Since there was no statistically significant difference among treatments of six different levels of protein, it is known that the level of protein was not the problem. The weight loss during these periods points out that the energy density of the rations was below optimum. The weight gain in Period Five is due to a drop in egg production. In Feeding Trial One, the net body weight changes over Periods 3, 4, and 5 were -131.5, -216.5, -153.2, +5.6, -120.6, and -77.9 grams per hen for Raions 1, 2, 3, 4, 5, and 6, respectively.

In Feeding Trial Two, higher energy density rations were used (360 kilocalories of metabolizable energy in each 120 grams of ration). Over Periods 3, 4, and 5 of this feeding trial, the net body weight changes were -20.8, -158.3, -85.0, -68.7, -35.8, and -47.6 grams per hen for Rations 1, 2, 3, 4, 5, and 6, respectively. After a substantial loss of weight at the onset of heavy egg production, only minimal weight losses were noted and, toward the end of the feeding trial

TABLE XVIII

PERIOD BODY WEIGHT CHANGE

FEEDING TRIAL ONE

Diet No.	Period Number				
	1	2	3	4	5
	(Grams per hen)				
1	104.3	-478.0	-222.5	-274.4	365.4
2	123.5	-560.5	-142.6	-134.5	60.6
3	12.7	-473.5	-139.0	-206.5	192.3
4	46.9	-481.9	- 89.4	-134.6	229.6
5	14.8	-475.1	- 90.2	-241.0	210.6
6	132.0	-498.4	- 95.1	-155.1	172.3
F	2.02	0.47	0.84	0.62	2.52*
EMS (df = 35)	11656.83	19240.27	25300.59	44605.83	30785.15

*Significant at .05 level of probability.

TABLE XIX

PERIOD BODY WEIGHT CHANGE

FEEDING TRIAL TWO

Diet No.	Period Number				
	1	2	3	4	5
	(Grams per hen)				
1	-459.6	-111.7	- 64.6	107.1	- 63.3
2	-443.3	- 76.7	- 27.5	- 34.2	- 96.6
3	-471.0	-140.2	- 39.4	16.5	- 62.1
4	-361.3	-118.8	-118.8	33.8	16.3
5	-388.3	-128.8	-102.9	119.2	- 52.1
6	-467.1	-104.2	-133.8	80.4	5.8
F	0.60	0.73	1.01	1.24	0.74
EMS (df = 35)	27950.51	5320.03	15125.22	22344.87	20723.23

TABLE XXII

EGGS PRODUCED

FEEDING TRIAL ONE

Diet No.	Period Number				
	1	2	3	4	5
	(Percent egg production)				
1	6.9	54.2	46.9	47.2	29.0
2	3.7	49.6	52.5	47.8	31.4
3	2.8	47.2	50.7	42.9	32.1
4	6.3	57.4	60.6	52.0	38.9
5	5.2	55.5	58.8	52.1	36.8
6	2.9	51.7	54.8	46.1	30.1
F	0.54	0.86	0.84	0.39	0.49
EMS (df = 35)	0.005	0.014	0.025	0.026	0.026

TABLE XXIII

EGGS PRODUCED

FEEDING TRIAL TWO

Diet No.	Period Number				
	1	2	3	4	5
	(Percent egg production)				
1	33.0	51.0	50.7	47.8	45.8
2	31.4	50.6	48.5	39.6	37.0
3	38.2	48.3	48.4	40.4	36.5
4	34.1	44.1	44.0	38.2	38.8
5	35.1	51.0	51.5	45.4	39.1
6	35.9	54.3	50.0	41.7	42.6
F	0.93	0.89	0.42	0.87	0.69
EMS (df = 35)	0.005	0.011	0.014	0.012	0.015

TABLE XXIV

EGGS LAID

FEEDING TRIAL ONE

Diet No.	Period Number				
	1	2	3	4	5
	(Average number per hen)				
1	1.9	15.2	13.1	13.2	8.1
2	1.0	13.9	14.7	13.4	8.8
3	0.8	13.2	14.2	12.0	9.0
4	1.8	16.1	17.0	14.6	10.9
5	1.5	15.5	16.5	14.6	10.3
6	0.8	14.5	15.3	12.9	8.4
F	0.54	0.86	0.84	0.39	0.49
EMS (df = 35)	3.64	10.67	19.26	20.33	19.98

TABLE XXV

EGGS LAID

FEEDING TRIAL TWO

Diet No.	Period Number				
	1	2	3	4	5
	(Average number per hen)				
1	9.3	14.3	14.2	13.4	12.8
2	8.8	14.2	13.6	11.1	10.4
3	10.7	13.5	13.5	11.3	10.2
4	9.5	12.4	12.3	10.7	10.9
5	9.8	14.3	14.4	12.7	11.0
6	10.0	15.2	14.0	11.7	11.9
F	0.93	0.89	0.42	0.87	0.69
EMS (df = 35)	3.81	8.23	10.60	9.73	11.60

(Period 4), weight gains were noted for all but one treatment. These weight gains were made while a fairly high level of egg production was maintained. The low weight losses, and even weight gains, together with a fairly high level of production over the entire feeding trial shows that the energy density of the rations was adequate.

Production Data

Eggs Produced

The percent eggs produced and the average number of eggs laid by the turkey breeder hens on each treatment are presented by periods in Tables XXII, XXIII, XXIV, and XXV. Over Periods 3, 4, and 5, the average percent egg production was 41.0, 43.9, 41.9, 50.5, 49.2, and 43.7 percent per hen for Rations 1, 2, 3, 4, 5, and 6, respectively, in Feeding Trial One; and 48.1, 41.7, 41.8, 40.3, 45.3, and 44.8, percent per hen for Rations 1, 2, 3, 4, 5, and 6, respectively, in Feeding Trial Two. Tere were no statistically significant differences among treatments in either feeding trial (Tables XXVI, XXVII, XXVIII, and XXIX).

It should be noted that in Feeding Trial Two a higher level of egg production was established for all treatments at the start of the feeding trial (Period 1) and that this high level of production was maintained for the duration of the feeding trial. This higher level of production was due to delayed sexual maturity, which was caused by light restriction and by feeding a low protein holding diet until the start of Feeding Trial Two. Delaying sexual maturity allowed all the hens to come into production at the same time and reduced the number of small eggs.

Egg Weight

There were no statistically significant differences among treat-
ments for average or total egg weight in any period of either feeding
trial (Tables XXX, XXXI, XXXII, and XXXIII). The means are presented
for each treatment by periods in Tables XXXIV, XXXV, XXXVI, and XXXVII
for average egg weight and total egg weight, respectively. The aver-
age egg weight in Periods 3, 4, and 5 was 63, 64, 63, 68, 62, and 63
grams for Rations 1, 2, 3, 4, 5, and 6, respectively, for Feeding
Trial One; and 67, 61, 63, 62, 67, and 66 grams for Rations 1, 2, 3, 4,
5, and 6, respectively, for Feeding Trial Two. The turkey breeder hens
were able to maintain their average egg size and total egg weight on
diets which contained graded dietary protein levels that ranged from
16.5 to 39.4 grams per hen per day.

The means shown in Period 2 of Feeding Trial One are much smaller
than those for the rest of the periods in the tables for total egg
weight, number of eggs set, percent and number of fertile eggs, hatch-
ability, and number of live poults. The reason these means are smaller
is because the data shown does not represent the entire period, but
only the last week of that period.

Reproductive Performance

Reproductive performance is represented by number of eggs set,
percent and number of fertile eggs, hatchability (percent of fertile
eggs set and percent of all eggs set), and number of live poults. Each
of these measures of reproductive performance is on an average per hen
basis. With one exception (percent hatchability of fertile eggs set,

TABLE XXXIV

AVERAGE EGG WEIGHT

FEEDING TRIAL ONE

Diet No.	Period Number				
	1	2	3	4	5
		(Grams)			
1		63	69	66	54
2		67	70	69	53
3		60	66	63	59
4		64	68	72	64
5		65	64	65	56
6		66	70	63	55
F		0.34	0.45	0.51	0.36
EMS (df = 35)		137.5	105.4	196.3	387.6

TABLE XXXV

AVERAGE EGG WEIGHT

FEEDING TRIAL TWO

Diet No.	Period Number				
	1	2	3	4	5
		(Grams)			
1		65	66	64	71
2		65	65	64	54
3		65	66	64	60
4		64	58	61	66
5		68	72	64	65
6		64	69	62	66
F		0.49	2.02	0.12	1.98
EMS (df = 35)		47.2	86.0	127.1	153.2

TABLE XXXVI

TOTAL EGG WEIGHT

FEEDING TRIAL ONE

Diet No.	Period Number				
	1	2	3	4	5
	(Grams per bird)				
1		213	904	906	588
2		224	997	922	627
3		213	953	799	684
4		246	1161	976	791
5		258	1166	1035	757
6		232	1017	838	601
F		0.48	0.88	0.58	0.46
EMS (df = 35)		5518.83	106583.44	104201.09	125044.23

TABLE XXXVII

TOTAL EGG WEIGHT

FEEDING TRIAL TWO

Diet No.	Period Number				
	1	2	3	4	5
	(Grams per bird)				
1		915	933	926	886
2		112	873	755	660
3		933	934	780	675
4		792	769	712	701
5		966	997	907	791
6		990	936	779	823
F		1.03	0.94	1.12	1.23
EMS (df = 35)		36605.34	52092.15	53392.29	53673.28

Period 2 of Feeding Trial Two), there were no statistically signifi-
cant differences among treatments for any of the factors used to mea-
sure reproductive performance during any period of either feeding
trial.

Number of Eggs Set

The average number of eggs set per hen in each treatment group is
presented by periods in Tables XXXVIII and XXXIX for Feeding Trial One
and Two, respectively. While there were no statistically significant
differences among treatments in either feeding trial (Tables XL and
XLI), Feeding Trial Two did consistently have error mean squares that
were one-half the size of the error mean squares of Feeding Trial One.
The smaller error mean squares shows that the variation among hens
within each treatment group was less. This uniformity of performance
of the hens in each treatment group of Feeding Trial Two was due to
the intentionally delayed sexual maturity of these turkey breeder hens.

Fertility

Percent fertility was good to excellent for all treatment groups
of both feeding trials (Table XLII and XLIII), with no statistical
difference among treatments for any period of either feeding trial
(Tables XLIV and XLV). In Periods 3, 4, and 5 of each feeding trial,
the percent fertility was 78.8, 73.6, 75.3, 75.9, 67.0, and 72.8 per-
cent (Feeding Trial One) and 83.8, 75.5, 75.5, 77.8, 74.1, and 71.8
percent (Feeding Trial Two) for Rations 1, 2, 3, 4, 5, and 6, respec-
tively.

The means for the number of fertile eggs produced by each treat-

TABLE XXXVIII

EGGS SET

FEEDING TRIAL ONE

Diet No.	Period Number				
	1	2	3	4	5
		(Average number per hen)			
1		3.0	12.8	12.4	7.5
2		3.2	14.1	12.5	8.1
3		3.0	13.4	10.6	8.5
4		3.6	16.3	13.3	10.4
5		3.5	15.5	13.5	9.8
6		3.4	14.3	11.7	8.0
F		0.45	0.74	0.44	0.54
EMS (df = 35)		1.02	18.38	19.68	18.59

TABLE XXXIX

EGGS SET

FEEDING TRIAL TWO

Diet No.	Period Number				
	1	2	3	4	5
		(Average number per hen)			
1		13.2	12.8	12.9	11.9
2		13.3	12.4	10.6	8.9
3		12.8	12.4	10.9	9.1
4		11.6	10.9	10.3	9.6
5		13.5	13.3	12.4	10.1
6		14.3	12.6	11.0	10.8
F		0.79	0.56	0.91	1.15
EMS (df = 35)		7.89	9.03	9.55	8.94

TABLE XLII

FERTILITY

FEEDING TRIAL ONE

Diet No.	Period Number				
	1	2	3	4	5
		(Percent)			
1		57.6	93.1	74.4	68.8
2		61.5	87.4	74.9	58.6
3		45.5	89.8	71.6	64.5
4		50.0	84.9	75.9	67.0
5		52.1	77.7	65.0	58.2
6		61.7	88.8	72.0	57.6
F		0.82	1.08	0.27	0.25
EMS (df = 35)		0.04	0.02	0.05	0.08

TABLE XLIII

FERTILITY

FEEDING TRIAL TWO

Diet No.	Period Number				
	1	2	3	4	5
		(Percent)			
1		90.5	83.6	80.9	87.0
2		85.8	81.7	85.3	59.6
3		82.4	78.7	83.5	64.4
4		93.6	74.1	82.5	76.9
5		88.8	82.5	72.8	67.0
6		78.2	79.5	66.1	69.8
F		0.92	0.32	1.46	2.20
EMS (df = 35)		0.03	0.03	0.03	0.04

ment group are presented by periods in Table XLVI and XLVII. As with percent fertile eggs, there were no statistically significant differ-ences among treatments for any period of Feeding Trial One or Feeding Trial Two. (Tables XLVIII and XLIX).

Hatchability

With one exception (percent hatchability of fertile eggs set, Period 2 of Feeding Trial Two), there were no statistically significant differences among treatments for either percent hatchability of fertile eggs set or percent hatchability of all eggs set for any period of Feeding Trial One or Feeding Trial Two (Tables L, LI, LII, and LIII). The means for percent hatchability of fertile eggs set and percent hatchability of all eggs set are presented by periods for each feeding trial in Tables LIV, LV, LVI, and LVII. Over Periods 3, 4, and 5, an average percent hatchability for fertile eggs set and all eggs set was calculated in each treatment group for each feeding trial. The average percent hatchability of fertile eggs was 43.5, 39.0, 39.1, 37.4, 36.9, and 35.5 percent (Feeding Trial One) and 38.0, 38.0, 40.5, 39.4, 41.8, and 40.1 percent (Feeding Trial Two) for Rations 1, 2, 3, 4, 5, and 6, respectively. The average percent hatchability of all eggs set was 40.2, 31.8, 34.8, 31.7, 30.3, and 31.6 percent (Feeding Trial One) and 33.7, 32.0, 36.0, 36.4, 34.9, and 32.1 percent (Feeding Trial Two) for Rations 1, 2, 3, 4, 5, and 6, respectively.

While fertility was high for both feeding trials, hatchability was low. It is not known why this was the case. Although the incubators used for hatching in these feeding trials were old and not always in peak operating condition, it is not felt that they were the cause of

TABLE XLVI

NUMBER OF FERTILE EGGS

FEEDING TRIAL ONE

Diet No.	Period Number				
	1	2	3	4	5
		(Average number per hen)			
1		1.9	11.8	10.7	6.8
2		2.1	12.5	9.3	6.3
3		1.7	12.5	8.9	7.6
4		1.9	14.4	10.1	7.6
5		2.1	13.6	9.8	7.3
6		2.3	13.0	9.3	6.6
F		0.35	0.38	0.24	0.16
EMS (df = 35)		0.80	17.4	13.7	15.3

TABLE XLVII

NUMBER OF FERTILE EGGS

FEEDING TRIAL TWO

Diet No.	Period Number				
	1	2	3	4	5
		(Average number per hen)			
1		12.4	11.0	11.7	10.7
2		11.2	10.5	9.7	6.6
3		11.5	10.9	10.2	7.0
4		10.8	9.4	9.5	8.5
5		12.0	10.9	10.8	7.3
6		11.7	9.8	8.9	7.9
F		0.26	0.44	0.85	1.78
EMS (df = 35)		9.19	8.06	9.40	9.89

TABLE LIV

HATCHABILITY

FEEDING TRIAL ONE

Diet No.	Period Number				
	1	2	3	4	5
	(Percent fertile eggs set)				
1		28.8	58.5	47.5	24.6
2		29.2	62.3	43.1	11.5
3		36.9	56.6	35.8	24.9
4		30.2	58.8	36.7	16.7
5		22.6	46.2	39.8	24.7
6		28.5	50.7	35.6	20.1
F		0.43	1.08	0.71	1.10
EMS (df = 35)		0.04	0.03	0.03	0.02

TABLE LV

HATCHABILITY

FEEDING TRIAL TWO

Diet No.	Period Number				
	1	2	3	4	5
	(Percent fertile eggs set)				
1		42.7	32.4	31.7	49.8
2		36.2	42.3	33.9	37.8
3		54.3	46.7	36.7	38.1
4		48.3	42.9	30.0	45.4
5		51.8	50.1	33.2	42.1
6		34.5	44.2	30.7	45.4
F		2.68*	1.26	0.14	0.44
EMS (df = 35)		0.02	0.02	0.03	0.04

*Significant at .05 level of probability.

TABLE LVI

HATCHABILITY

FEEDING TRIAL ONE

Diet No.	Period Number				
	1	2	3	4	5
		(Percent all eggs set)			
1		21.9	55.6	41.7	23.2
2		22.9	53.5	33.6	8.4
3		23.3	52.3	28.8	23.4
4		21.7	52.8	29.5	12.7
5		17.4	42.1	30.3	17.9
6		23.6	47.7	29.2	17.8
F		0.14	0.83	0.98	1.23
EMS (df = 35)		0.03	0.02	0.03	0.02

TABLE LVII

HATCHABILITY

FEEDING TRIAL TWO

Diet No.	Period Number				
	1	2	3	4	5
		(Percent all eggs set)			
1		41.0	29.5	28.6	43.0
2		32.6	36.4	31.4	28.2
3		48.6	41.8	34.5	31.8
4		46.5	38.5	27.8	42.9
5		47.3	43.3	29.2	32.2
6		30.0	36.7	24.5	35.1
F		2.24	0.92	0.30	1.02
EMS (df = 35)		0.02	0.02	0.03	0.03

the low hatchability rates. As there were no statistically signifi-
cant differences among treatments, it is known that the level of
dietary protein was not the cause of the low hatchability.

High fertility and low hatchability in caged turkey breeder hens
was a point of discussion at the Poultry Science Association annual
meeting in August, 1974. It was pointed out that a commercial turkey
breeder placed some cages in his breeder house. The hens placed in
the cages were picked up off the floor at random. The hens in the
cages and on the floor were on the same feed and under the same manage-
ment conditions. It was found that while egg production and fertility
were the same, hatchability was substantially low for the caged breed-
er hens. It is not known whether the turkey breeder hen obtains some-
thing off the floor, from the litter or the droppings, that she cannot
obtain when caged that would allow higher hatchability but the needs of
the caged turkey breeder hen apparently are not being met completely.

During this meeting, it was suggested by Dr. Earl Gleaves of the
University of Nebraska that the phosphorus to calcium ratio might be
wrong. That perhaps the phosphorus level was too high and that it
caused the low hatchability. The need for additional research is
apparent, and work which deals with the phosphorus requirements of
caged turkey breeder hens might be the next logical step.

Number of Live Poults

The mean values for number of live poults per hen for each treat-
ment group are presented in Tables LVII and LIX. An average number of
live poults per hen per period for each treatment group in Periods 3,
4, and 5 was 5.2, 4.1, 4.6, 4.8, 5.3, and 4.4 poults for Rations 1, 2,

TABLE LVIII

NUMBER OF POULTS PER HEN

FEEDING TRIAL ONE

Diet No.	Period Number				
	1	2	3	4	5
		(Average live poults hatched)			
1		0.75	7.44	6.10	2.06
2		0.83	7.81	3.67	0.83
3		0.73	7.88	3.46	2.35
4		0.75	9.13	4.13	1.23
5		0.69	7.23	6.67	1.98
6		0.83	7.60	4.19	1.50
F		0.10	0.36	1.24	1.02
EMS (df = 35)		0.28	9.96	5.85	2.56

TABLE LIX

NUMBER OF POULTS PER HEN

FEEDING TRIAL TWO

Diet No.	Period Number				
	1	2	3	4	5
		(Average live poults hatched)			
1		5.83	3.92	4.25	5.58
2		4.29	5.00	3.79	3.24
3		6.75	5.73	4.21	3.54
4		5.65	4.88	3.67	4.79
5		6.17	5.71	4.58	4.04
6		4.75	5.25	3.25	4.29
F		1.37	1.09	0.37	1.12
EMS (df = 35)		4.84	3.29	4.99	5.18

3, 4, 5, and 6, respectively, for Feeding Trial One; and was 4.6, 4.0, 4.5, 4.5, 4.8, and 4.3 poults for Rations 1, 2, 3, 4, 5, and 6, respectively, for Feeding Trial Two. As with most other factors used to measure reproductive performance, there were no statistically significant differences among treatments for any period of either feeding trial (Tables LX and LXI).

CHAPTER V

CONCLUSIONS

Feed Consumption

The amount of feed that the turkey breeder hen will consume in one day can be varied by the energy density of the feed. It has been found, that under an ad libitum feeding program, a 10 to 12 pound turkey breeder hen easily will consume 120 grams of feed per hen per day at the energy levels used in Feeding Trial One and Feeding Trial Two. This data provides a firm basis which can be used to estimate feed consumption for use in the formulation of turkey breeder rations.

Energy Requirement

The energy content of a diet has been shown to be an intake regulator for the turkey breeder hen. The results of Feeding Trial One and Two show that this small-type turkey breeder hen will consume approximately 360 kilocalories of metabolizable energy per hen per day. A ration formulated to contain 360 kilocalories of metabolizable energy per 120 grams of feed would closely regulate the amount of dietary protein and other nutrients consumed by the hens. However, if protein was less expensive than energy or if additional protein was thought to be needed, the amount of energy could be lowered by 10 to 15 kilocalories to allow the additional feed consumption.

Protein Requirement

Graded dietary protein levels which ranged from 16.5 to 39.4 grams of protein per hen per day have been fed with no statistically significant differences in egg production or reproductive performance. This points out that the protein requirement is not as high as thought to be by many research workers and commercial poultrymen. The data on actual protein intake from Feeding Trial Two support the conclusion that the dietary protein intake need be no higher than 16.5 grams of protein per hen per day. The actual daily protein requirement may be lower than this based upon egg production and reproductive performance data, but further research must be conducted before the actual level can be established.

Phosphorus and Calcium Requirements

Recent work by Waldroup et al. (1974) indicated the phosphorus and calcium requirements might be considerably lower than those used in these feeding trials. Levels of 3.07 percent calcium and 0.9 percent phosphorus were used in these feeding trials. Waldroup states that a minimum inorganic phosphorus level of 0.3 percent at a 2.25 percent calcium level is necessary to support reproductive performance. Waldroup's work and the low hatchability of these feeding trials points out the need for additional research to be conducted with regard to amount and ratio of phosphorus and calcium for caged turkey breeder hens.

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APPENDIX

TABLE VIII

ANALYSIS OF VARIANCE FOR FEED CONSUMPTION - 73

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47	103.0689	297.5157	505.1352	991.6184	452.1442
Table	1	1596.0486	2187.6429	375.3473	5365.7552	6.1225
Side	1	33.0364	32.7408	182.8730	294.6668	150.7317
Table x Side	1	96.4346	1260.8720	89.6403	138.9468	2847.4969
End	1	46.8875	19.5014	19.3500	3761.9668	496.3011
Table x End	1	534.5245	151.1539	140.5719	7.6059	42.2992
Side x End	1	89.3152	5.5822	0.2398	3753.5402	2583.4290
Table x Side x End	1	84.5099	4.1112	33.2342	122.2636	131.7508
Treatment	5	28.2066	111.9609	1507.1045	910.4399	384.0379
Error	35	63.4985	278.9094	438.9879	817.4034	373.4988
Treatment F Value		0.4442	0.4014	3.4331*	1.1138	1.0282

*Significant at .05 level of probability.

TABLE IX

ANALYSIS OF VARIANCE FOR FEED CONSUMPTION - 74

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47	116.1836	144.6520	237.3090	358.9825	357.9784
Table	1	468.0063	168.3039	232.5610	2176.4057	198.8941
Side	1	17.4346	345.0258	996.9076	479.9772	491.5276
Table x Side	1	162.5579	375.6803	13.2075	1079.3840	12.9899
End	1	40.8588	301.7884	883.1639	0.2483	600.6085
Table x End	1	25.6947	126.2861	202.1791	18.1595	9.1199
Side x End	1	161.2460	11.3426	178.4847	1127.3254	354.1822
Table x Side x End	1	412.5106	1300.8436	414.2574	435.8658	61.5967
Treatment	5	38.3418	118.3177	197.5712	327.4717	151.9787
Error	35	113.7317	102.2224	206.9973	283.3558	409.6049
Treatment F Value		0.3371	1.1575	0.9545	1.1557	0.3710

TABLE XII

ANALYSIS OF VARIANCE FOR KILOCALORIES OF ENERGY CONSUMPTION - 73

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47	802.0107	2315.0618	3930.6140	7716.0901	3518.2746
Table	1	12419.3491	17022.7282	2920.6938	41752.6060	47.6407
Side	1	257.0663	254.7660	1422.9918	2292.8936	1172.8903
Table x Side	1	750.3872	9811.2364	697.5191	1081.1878	22157.2567
End	1	364.8460	151.7467	150.5681	29273.0311	3861.8728
Table x End	1	4159.3008	1176.1757	1093.8332	59.1838	329.1431
Side x End	1	694.9896	43.4368	1.8661	29207.4609	20102.4625
Table x Side x End	1	657.5980	31.9902	258.6056	951.3713	1025.1935
Treatment	5	219.4844	871.2023	11727.2474	7084.4150	2988.3181
Error	35	494.1013	2170.2804	3415.9012	6360.4693	2906.3102
Treatment F Value		0.4442	0.4014	3.4331*	1.1138	1.0282

*Significant at .05 level of probability.

TABLE XIII

ANALYSIS OF VARIANCE FOR KILOCALORIES OF ENERGY CONSUMPTION - 74

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47	1045.6522	1301.8676	2135.7807	3230.8422	3221.8052
Table	1	4212.0562	1514.7348	2093.0491	19587.6515	1790.0472
Side	1	156.9117	3105.2322	8972.1680	4319.7943	4423.7486
Table x Side	1	1463.0208	3381.1224	118.8676	9714.4558	116.9087
End	1	367.7296	2716.0953	7948.4754	2.2348	5405.476
Table x End	1	231.2527	1136.5753	1819.6116	163.4354	82.0793
Side x End	1	1451.2144	102.0833	1606.3623	10145.9290	3187.6392
Table x Side x End	1	3712.5957	11707.5919	3728.3170	3922.7918	554.3701
Treatment	5	345.0760	1064.8592	1778.1406	2947.2449	1367.8087
Error	35	1023.5855	920.0013	1862.9753	2550.2020	3686.4437
Treatment F Value		0.3371	1.1575	0.9545	1.1557	0.3710

TABLE XIV

ANALYSIS OF VARIACNE FOR PROTEIN CONSUMPTION - 73

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47	14.1983	25.1717	42.6084	87.0713	49.1922
Table	1	100.5270	139.1218	20.4003	365.5664	0.4027
Side	1	2.4521	1.5970	5.3306	12.1239	7.7094
Table x Side	1	7.5576	76.4385	11.2346	2.6514	185.4746
End	1	3.2086	1.1502	1.3567	252.2380	28.3842
Table x End	1	40.0570	8.6398	4.8836	0.0284	3.7564
Side x End	1	4.0447	1.1086	0.3896	269.3662	162.6169
Table x Side x End	1	8.2151	1.2650	4.4698	6.1376	8.8413
Treatment	5	70.0537	65.2769	184.6684	250.2987	211.1211
Error	35	4.3140	17.9246	29.4625	55.2213	24.5495
Treatment F Value		16.2387**	3.6417**	6.2679**	4.5327**	8.5998**

**Significant at .01 level of probability.

TABLE XV

ANALYSIS OF VARIANCE FOR PROTEIN CONSUMPTION - 74

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47	11.4210	14.8768	21.9699	23.6281	31.2001
Table	1	14.4091	5.0521	4.4694	73.2602	5.5730
Side	1	0.3039	11.4845	27.3412	11.6362	15.0033
Table x Side	1	3.5575	15.8079	1.6159	55.5838	0.0043
End	1	0.5924	10.6761	33.2288	0.0108	15.3321
Table x End	1	0.8837	3.2378	7.5908	0.5340	2.4974
Side x End	1	3.5078	0.3053	8.7155	37.1644	11.9452
Table x Side x End	1	14.2848	41.8263	14.8144	7.6687	3.1387
Treatment	5	76.7656	98.2037	133.6424	112.9537	187.5016
Error	35	3.2978	3.4229	7.6171	10.2827	13.5830
Treatment F Value		23.2781**	28.6898**	17.5451**	10.9848**	13.8042**

**Significant at the .01 level of probability.

TABLE XX

ANALYSIS OF VARIANCE FOR PERIOD BODY WEIGHT CHANGE - 73

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47	22458.639	23601.950	23897.651	69447.073	67854.117
Table	1	238948.148	6533.333	46875.000	61275.521	109570.370
Side	1	30.613	27313.021	7211.169	525705.787	583002.083
Table x Side	1	136000.521	165870.891	1772.280	31008.333	131252.083
End	1	24075.521	7625.521	4281.482	499868.113	619559.259
Table x End	1	124542.187	32987.558	6768.750	8138.021	14700.000
Side x End	1	978.009	115378.704	61752.836	368667.593	214668.750
Table x Side x End	1	5278.009	35208.333	3034.780	69261.343	51352.083
Treatment	5	23542.766	8992.986	21194.549	27776.759	77511.759
Error	35	11656.834	19240.268	25300.587	44605.827	30785.146
Treatment F Value		2.019	0.467	0.838	0.623	2.518*

*Significant at .05 level of probability.

TABLE XXI

ANALYSIS OF VARIANCE FOR PERCENT BODY WEIGHT CHANGE - 74

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47	34044.611	6380.200	17799.309	25135.785	26323.426
Table	1	37688.021	2338.021	12620.891	2826.447	21710.431
Side	1	163138.947	229.688	13725.058	765.336	72527.792
Table x Side	1	1118.113	1772.280	11051.447	36575.521	47554.528
End	1	31775.521	10257.002	12729.225	2155.613	27832.306
Table x End	1	119833.391	3882.002	68377.836	847.280	151032.422
Side x End	1	64655.613	7428.558	47607.002	82363.947	29626.172
Table x Side x End	1	119168.113	1537.558	64655.613	134938.021	84658.001
Treatment	5	16890.243	3872.836	15283.576	27767.836	15389.251
Error	35	27950.508	5320.031	15125.217	22344.873	20723.232
Treatment F Value		0.604	0.728	1.010	1.243	0.743

TABLE XXVI

ANALYSIS OF VARIANCE FOR PERCENT EGG PRODUCTION - 73

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47	0.0046	0.0141	0.0260	0.0331	0.0328
Table	1	0.0143	0.0823	0.1011	0.2466	0.1308
Side	1	0.0056	0.0007	0.0020	0.0357	0.1049
Table x Side	1	0.0024	0.0314	0.0775	0.0682	0.0081
End	1	0.0098	0.0010	0.0439	0.1658	0.2578
Table x End	1	0.0088	0.0117	0.0023	0.0538	0.0088
Side x End	1	0.0000	0.0025	0.0149	0.0239	0.0361
Table x Side x End	1	0.0002	0.0002	0.0184	0.0010	0.0408
Treatment	5	0.0025	0.0117	0.0207	0.0102	0.0124
Error	35	0.0046	0.0136	0.0246	0.0259	0.0255
Treatment F Value		0.5350	0.8603	0.8416	0.3931	0.4869

TABLE XXVII

ANALYSIS OF VARIANCE FOR PERCENT EGG PRODUCTION - 74

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47	0.0054	0.0184	0.0144	0.0169	0.0135
Table	1	0.0062	0.0301	0.0418	0.1094	0.0427
Side	1	0.0189	0.0491	0.0351	0.0001	0.0073
Table x Side	1	0.0086	0.1158	0.0043	0.0899	0.0014
End	1	0.0229	0.0514	0.0307	0.0226	0.0028
Table x End	1	0.0000	0.0418	0.0036	0.0069	0.0072
Side x End	1	0.0017	0.0045	0.0203	0.0226	0.0000
Table x Side x End	1	0.0010	0.1562	0.0384	0.0550	0.0055
Treatment	5	0.0045	0.0094	0.0056	0.0107	0.0103
Error	35	0.0049	0.0105	0.0135	0.0124	0.0148
Treatment F Value		0.9266	0.8922	0.4174	0.8656	0.6931

TABLE XXVIII

ANALYSIS OF VARIANCE FOR NUMBER OF EGGS LAID - 73

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47	3.6031	11.0914	20.4066	25.9156	25.7116
Table	1	11.1811	64.5579	79.2245	193.3356	102.5700
Side	1	4.3802	0.5208	1.5648	28.0093	82.2506
Table x Side	1	1.8802	25.0370	60.7500	53.4815	6.3802
End	1	7.6534	0.7500	34.4537	130.0208	202.1302
Table x End	1	6.8756	9.1875	1.8148	42.1875	6.8756
Side x End	1	0.0006	1.9468	11.6690	18.7500	28.2645
Table x Side x End	1	0.1302	0.1481	14.4468	0.7500	31.9589
Treatment	5	1.9492	9.1745	16.2093	7.9917	9.7297
Error	35	3.6428	10.6650	19.2611	20.3298	19.9819
Treatment F Value		0.5350	0.8603	0.8416	0.3931	0.4869

TABLE XXIX

ANALYSIS OF VARIANCE FOR NUMBER OF EGGS LAID = 74

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47	4.1978	14.4023	11.2729	13.2589	10.6129
Table	1	4.8981	23.6134	32.7801	85.7784	33.4724
Side	1	14.8148	38.5208	27.5023	0.0700	5.7293
Table x Side	1	6.7500	90.7500	3.3426	70.4867	1.0951
End	1	17.9259	40.3333	24.0833	17.7228	2.1888
Table x End	1	0.0093	32.7801	2.8356	5.4950	5.6147
Side x End	1	1.3333	3.5208	15.9468	17.7228	0.0245
Table x Side x End	1	0.7500	122.4537	30.0833	43.1302	4.3300
Treatment	5	3.5259	7.3468	4.4259	8.4256	8.0423
Error	35	3.8053	8.2343	10.6034	9.7338	11.6040
Treatment F Value		0.9266	0.8922	0.4174	0.8656	0.6931

TABLE XXX

ANALYSIS OF VARIANCE FOR AVERAGE EGG WEIGHT - 73

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47		150.1745	94.7899	216.0313	465.2386
Table	1		298.2498	233.5245	1448.6722	619.8236
Side	1		3.7093	0.6968	82.4285	3170.1924
Table x Side	1		521.6279	208.3256	315.9497	690.3138
End	1		43.7104	53.6538	421.1223	1148.9390
Table x End	1		222.2361	11.8466	498.9746	710.7739
Side x End	1		866.9528	2.0061	2.6311	451.2811
Table x Side x End	1		54.9528	21.7913	11.9881	814.7590
Treatment	5		47.1933	47.0185	100.4082	139.1076
Error	35		137.4513	105.3769	196.2761	387.5598
Treatment F Value			0.3434	0.4462	0.5116	0.3589

TABLE XXXI

ANALYSIS OF VARIANCE FOR AVERAGE EGG WEIGHT - 74

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47		43.6495	98.1645	156.3707	182.2709
Table	1		21.6891	82.7619	637.7322	270.2899
Side	1		74.6698	10.9177	504.5519	106.4285
Table x Side	1		4.8894	39.3387	820.6188	3.6999
End	1		1.8767	23.0654	15.1033	74.7204
Table x End	1		60.0579	107.2534	18.1774	196.6724
Side x End	1		22.2916	454.1440	415.6327	485.5553
Table x Side x End	1		98.4947	17.2280	412.2719	549.2411
Treatment	5		23.0740	173.9569	15.3811	303.5352
Error	35		47.2054	85.9782	127.0979	153.2128
Treatment F Value			0.4888	2.0233	0.1210	1.9811

TABLE XXXII

ANALYSIS OF VARIANCE FOR TOTAL EGG WEIGHT - 73

SOURCE	df	Mean Square by Period			
		1 2	3	4	5
Total	47	4789.336	105649.769	130364.303	160825.320
Table	1	5417.688	289701.867	848535.651	714549.940
Side	1	387.888	6069.001	106746.031	429134.090
Table x Side	1	8056.196	239903.954	243591.882	14996.060
End	1	81.945	102019.300	665644.681	1205292.190
Table x End	1	3140.916	20528.898	200550.771	15007.850
Side x End	1	831.251	32021.279	98088.521	280135.880
Table x Side x End	1	804.285	74476.511	16652.613	238175.020
Treatment	5	2643.898	94079.625	60054.780	56990.190
Error	35	5518.832	106583.435	104201.092	125044.230
Treatment F Value		0.479	0.883	0.576	0.456

TABLE XXXIII

ANALYSIS OF VARIANCE FOR TOTAL EGG WEIGHT - 74

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47		65514.606	54506.650	67599.217	52973.541
Table	1		149194.433	41548.101	392197.389	117676.359
Side	1		139435.707	117744.037	6523.226	27431.625
Table x Side	1		455442.403	1893.378	222283.057	25117.513
End	1		192048.084	109112.184	119224.590	33507.782
Table x End	1		133763.525	9599.363	3796.742	35504.160
Side x End	1		2929.167	109309.341	108981.903	521.071
Table x Side x End	1		535948.378	105575.027	157212.336	40812.919
Treatment	5		37847.551	48761.168	59642.763	66124.058
Error	35		36605.343	52092.151	53392.290	53673.277
Treatment F Value			1.034	0.936	1.117	1.232

TABLE XL

ANALYSIS OF VARIANCE FOR NUMBER OF EGGS SET - 73

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47		0.8883	18.0870	23.5081	24.8538
Table	1		1.4468	58.5208	127.8356	118.2315
Side	1		0.0833	0.7500	10.7037	56.3333
Table x Side	1		1.0208	34.4537	32.7801	3.7037
End	1		0.0023	19.1690	125.6690	188.0208
Table x End	1		0.9259	7.0023	62.2593	7.5208
Side x End	1		0.0875	10.0833	11.6690	48.6690
Table x Side x End	1		0.0370	8.8981	1.5648	44.7245
Treatment	5		0.4583	13.5569	8.6981	10.0662
Error	35		1.0216	18.3837	19.6831	18.5884
Treatment F Value			0.4487	0.7375	0.4419	0.5415

TABLE XLI

ANALYSIS OF VARIANCE FOR NUMBER OF EGGS SET - 74

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47		14.1461	9.3459	12.7340	8.7021
Table	1		18.3356	5.5579	80.5145	24.0833
Side	1		44.7245	21.7801	0.1302	3.8912
Table x Side	1		99.1875	0.6690	58.1534	2.3704
End	1		35.5926	19.5926	20.2367	5.3333
Table x End	1		35.5926	9.4815	8.7552	3.1690
Side x End	1		3.7037	20.4537	17.7228	0.4537
Table x Side x End	1		120.3333	20.4537	35.3061	5.1134
Treatment	5		6.2597	5.0528	8.6672	10.3245
Error	35		7.8886	9.0287	9.5527	8.9417
Treatment F Value			0.7935	0.5596	0.9073	1.1547

TABLE XLIV

ANALYSIS OF VARIANCE FOR PERCENT FERTILE EGGS - 73

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47		0.0466	0.0215	0.0456	0.0756
Table	1		0.0563	0.0270	0.0692	0.0058
Side	1		0.1251	0.0712	0.0644	0.2379
Table x Side	1		0.2861	0.0000	0.0058	0.1383
End	1		0.0054	0.0709	0.0877	0.1199
Table x End	1		0.0300	0.0015	0.1504	0.0577
Side x End	1		0.0373	0.0013	0.0464	0.1164
Table x Side x End	1		0.0002	0.0000	0.0119	0.0359
Treatment	5		0.0347	0.0224	0.0125	0.0194
Error	35		0.0422	0.0208	0.0469	0.0784
Treatment F Value			0.8212	1.0761	0.2663	0.2476

TABLE XLV

ANALYSIS OF VARIANCE FOR PERCENT FERTILE EGGS - 74

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47		0.0257	0.0347	0.0423	0.0429
Table	1		0.0034	0.3405	0.1632	0.1456
Side	1		0.0076	0.0569	0.0456	0.0572
Table x Side	1		0.0046	0.0781	0.0463	0.0390
End	1		0.0000	0.0081	0.0280	0.0008
Table x End	1		0.0927	0.0110	0.0823	0.1064
Side x End	1		0.0089	0.0475	0.0340	0.0533
Table x Side x End	1		0.0075	0.0222	0.0930	0.0008
Treatment	5		0.0251	0.0094	0.0448	0.0771
Error	35		0.0274	0.0292	0.0307	0.0351
Treatment F Value			0.9166	0.3226	1.4615	2.1983

TABLE XLVIII

ANALYSIS OF VARIANCE FOR NUMBER OF FERTILE EGGS - 73

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47		0.7329	15.5677	15.7648	17.1682
Table	1		1.2245	41.2552	57.4219	64.9450
Side	1		1.0208	5.4450	0.6302	16.9219
Table x Side	1		2.3704	6.3802	0.6302	0.4867
End	1		0.2315	5.2228	82.2506	98.7089
Table x End	1		0.1134	21.1117	71.2969	8.4728
Side x End	1		0.1134	7.9219	29.8200	56.6950
Table x Side x End	1		0.0833	2.5978	1.2784	12.8478
Treatment	5		0.2819	6.6700	3.3395	2.4659
Error	35		0.7965	17.3827	13.7405	15.3002
Treatment F Value			0.3540	0.3837	0.2430	0.1612

TABLE XLIX

ANALYSIS OF VARIANCE FOR NUMBER OF FERTILE EGGS - 74

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47		13.5909	10.1792	12.3552	10.4149
Table	1		9.0422	57.7870	68.4815	27.7552
Side	1		14.6302	40.3333	2.2245	14.6302
Table x Side	1		92.1302	11.0208	57.0579	1.7506
End	1		28.7784	25.0370	27.5023	7.1302
Table x End	1		58.8895	3.1690	11.0208	2.1534
Side x End	1		2.7552	13.0208	3.7037	1.1719
Table x Side x End	1		98.7089	28.0093	41.5648	0.4867
Treatment	5		2.4330	3.5653	8.0000	17.6242
Error	35		9.1907	8.0634	9.4040	9.8943
Treatment F Value			0.2647	0.4422	0.8507	1.7813

TABLE L

ANALYSIS OF VARIANCE FOR PERCENT OF FERTILE EGGS HATCHED = 73

SOURCE	df	Mean Square by Period 1	2	3	4	5
Total	47		0.0416	0.0265	0.0315	0.0243
Table	1		0.2307	0.0028	0.0845	0.0361
Side	1		0.0857	0.0133	0.0190	0.0005
Table x Side	1		0.0501	0.0007	0.0083	0.0396
End	1		0.0270	0.0575	0.0736	0.1167
Table x End	1		0.0405	0.0406	0.2194	0.0012
Side x End	1		0.0297	0.0754	0.0832	0.0040
Table x Side x End	1		0.0465	0.0009	0.0001	0.0636
Treatment	5		0.0167	0.0282	0.0182	0.0239
Error	35		0.0389	0.0261	0.0257	0.0217
Treatment F Value			0.4303	1.0800	0.7094	1.0979

TABLE LI

ANALYSIS OF VARIANCE FOR PERCENT OF FERTILE EGGS HATCHED - 74

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47		0.0278	0.0301	0.0340	0.0377
Table	1		0.0555	0.0819	0.0648	0.0909
Side	1		0.0270	0.0156	0.0136	0.0533
Table x Side	1		0.0192	0.0556	0.0746	0.0000
End	1		0.0002	0.1650	0.1386	0.1151
Table x End	1		0.0115	0.0021	0.0028	0.0004
Side x End	1		0.2169	0.1513	0.0737	0.0000
Table x Side x End	1		0.0105	0.0072	0.0195	0.0481
Treatment	5		0.0536	0.0285	0.0047	0.0174
Error	35		0.0200	0.0226	0.0339	0.0393
Treatment F Value			2.6817*	1.2605	0.1396	0.4433

*Significant at .05 level of probability.

TABLE LII

ANALYSIS OF VARIANCE FOR PERCENT OF TOTAL EGGS HATCHED - 73

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47		0.0282	0.0225	0.0257	0.0231
Table	1		0.1052	0.0066	0.0676	0.0122
Side	1		0.0440	0.0481	0.0437	0.0083
Table x Side	1		0.0301	0.0075	0.0020	0.0290
End	1		0.0624	0.0090	0.0435	0.0695
Table x End	1		0.0090	0.0447	0.2003	0.0013
Side x End	1		0.0000	0.0291	0.0500	0.0008
Table x Side x End	1		0.0168	0.0004	0.0000	0.0421
Treatment	5		0.0043	0.0194	0.0196	0.0276
Error	35		0.0296	0.0233	0.0200	0.0225
Treatment F Value			0.1439	0.8328	0.9787	1.2299

TABLE LIII

ANALYSIS OF VARIANCE FOR PERCENT OF TOTAL EGGS HATCHED - 74

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47		0.0297	0.0300	0.0312	0.0311
Table	1		0.0581	0.1864	0.0423	0.0798
Side	1		0.0249	0.0245	0.0101	0.0889
Table x Side	1		0.0137	0.0919	0.0691	0.0032
End	1		0.0004	0.1806	0.1569	0.0810
Table x End	1		0.0055	0.0077	0.0061	0.0007
Side x End	1		0.2040	0.1005	0.0445	0.0053
Table x Side x End	1		0.0276	0.0049	0.0145	0.0248
Treatment	5		0.0515	0.0189	0.0092	0.0300
Error	35		0.0230	0.0205	0.0307	0.0294
Treatment F Value			2.2387	0.9199	0.2997	1.0199

TABLE LX

ANALYSIS OF VARIANCE FOR NUMBER OF LIVE POULTS - 73

SOURCE	df	Mean Square by Period				
		1	2	3	4	5
Total	47		0.2929	9.1617	7.0413	2.7234
Table	1		2.0833	6.0208	1.2245	8.8981
Side	1		0.5926	7.7870	1.6875	0.9259
Table x Side	1		0.1481	0.0579	1.2245	0.0208
End	1		0.5926	7.5208	26.5023	12.3356
Table x End	1		0.1481	23.1481	57.0579	0.1481
Side x End	1		0.0093	18.3356	1.6875	0.0370
Table x Side x End	1		0.2315	1.1204	0.8356	2.8356
Treatment	5		0.0273	3.5898	7.2231	2.6245
Error	35		0.2308	9.9618	5.8459	2.5621
Treatment F Value			0.0973	0.3604	1.2356	1.0244

TABLE LXI

ANALYSIS OF VARIANCE FOR NUMBER OF LIVE POULTS - 74

SOURCE	df	Mean Square by Period			
		2	3	4	5
Total	47	6.7257	5.3924	5.7145	5.8214
Table	1	0.0145	22.4589	10.0833	14.1738
Side	1	2.7552	17.7228	0.4537	19.4863
Table x Side	1	44.4034	18.9589	10.0833	0.0765
End	1	3.6117	35.3061	52.0833	24.9168
Table x End	1	5.2228	2.4450	1.5648	0.4701
Side x End	1	14.6302	18.5422	8.8981	1.3057
Table x Side x End	1	43.1302	4.7922	1.5648	2.7154
Treatment	5	6.6080	3.5950	1.8444	5.8234
Error	35	4.8371	3.2926	4.9894	5.1814
Treatment F Value		1.3661	1.0918	0.3697	1.1237

VITA ⌐

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Master of Science

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