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University of Tennessee Agricultural Experiment Station

R. H. Harms

G. C. McGhee

O. E. Goff

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R. H. HARMS

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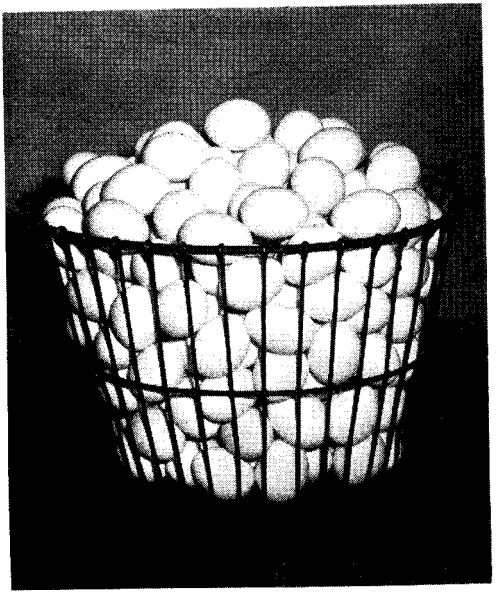
O. E. GOFF



AGRICULTURAL EXPERIMENT STATION
THE UNIVERSITY OF TENNESSEE
KNOXVILLE

The Effect of Dietary Energy Level on the Performance of Laying Hens

R. H. HARMS
Assistant Poultry Nutritionist

G. C. McGHEE
Superintendent, Poultry Farm

O. E. GOFF
Head, Poultry Department

INTRODUCTION

Relatively few studies are reported in the literature on the dietary energy requirement of the laying hen. Heuser *et al.* (1945) showed that a feed low in fiber content supported a higher rate of egg production than similar feeds high in fiber. Bird and Whitson (1946) showed that the efficiency of a feed was related inversely to fiber content. Lillie *et al.* (1952) observed a marked improvement in the efficiency of egg production when lard was incorporated into the diet. Singsen *et al.* (1952) and Gerry (1954) have reported higher efficiency with diets high in energy value as compared with low energy diets.

Hill *et al.* (1956) compared the performance of hens receiving 740, 840, and 930 calories of productive energy (1) per pound in a 17.5% protein laying mash, and hens receiving 945, 985, and 1025 calories of productive energy per pound of 16.5 percent laying mash. They found that with each increase in energy a corresponding increase was obtained in egg production, and less feed was required to produce a dozen eggs. However, they stated that the rate of egg production was affected by energy level only during cold weather.

Berg and Bearse (1956) found no difference in egg production from hens fed diets containing 1,148 and 1,331 calories of metabolizable energy (2) per pound in a 15 percent laying diet. However, they did find the high energy diet promoted the greatest efficiency of feed utilization.

The studies reported in this bulletin were conducted in an effort to evaluate further the energy requirement of the laying hen. Single Comb White Leghorns and two meat-type breeds were used in this work. A basal diet containing 19.2 percent protein was used in an effort to avoid any possibility of a protein deficiency.

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[1] Productive energy (according to Fraps) "is the net energy as measured by the energy stored up as fat and protein in a growing or fattening animal."

[2] Metabolizable energy (according to Fraps) "is the energy in food less the energy in the excrement . . . It includes all the energy of the food which can be used by the animal."

EXPERIMENTAL PROCEDURE

These experiments were conducted with April hatched pullets during their first production year. In Experiment I, each of the 1954-55 diets (Table 1) was fed to birds in duplicate pens containing 60 Single Comb White Leghorn pullets each. In Experiment II, each of the 1955-56 diets (Table 1) was fed to duplicate pens each containing 50 Single Comb White Leghorn pullets. Each of the 1955-56 diets, Experiment III, was fed to one pen of 42 White Plymouth Rock pullets and one pen of 50 New Hampshire pullets.

All pullets were in approximately 20 percent egg production when they were placed at random into their respective experimental pens.

The diets used in these tests were formulated using common feedstuffs. The high energy diet was estimated to contain approximately 900 calories of productive energy per pound as calculated from the data of Fraps (1946). This diet was modified to form the low energy diet containing 721 calories per pound as shown in Table 1. In order to avoid any possibility of a protein deficiency, each of these diets contained approximately 19.2 percent protein.

Each pen was equipped with individual nests, an automatic water supply and two feeders each five feet long, accessible from both sides. The all-mash diets were fed *ad libitum* with oyster shells and granite grit. Wood shavings were used as litter and a dropping pit was provided in each pen. Supplemental lights were provided when necessary to provide a minimum day length of 14 hours.

Egg production was calculated by months on a hen-day basis. Feed efficiency is expressed as pounds of feed per dozen eggs, calculated at monthly intervals. All birds were individually weighed at

Table I—Composition of Diets

Ingredients	Lbs./cwt.			
	High Energy		Low Energy	
	1954-55	1955-56	1954-55	1955-56
Yellow Corn	63.0	63.0	25.5	25.5
Oats	——	——	20.0	20.0
Wheat Shorts	——	——	20.0	20.0
Alfalfa Leaf Meal	5.0	5.0	10.0	10.0
Meat Scraps	5.0	5.0	5.0	5.0
Soybean Oil Meal (44% Protein)	23.5	23.5	16.0	16.0
Ground Limestone	1.0	1.0	1.0	1.0
Defluorinated Phosphate	1.0	1.5	1.0	1.5
Salt	1.0	0.5	1.0	0.5
Vitamin Mix	0.5[1]	0.5[2]	0.5[1]	0.5[2]
Calories of productive energy/lb. feed[3]	900		721	

[1] Supplied per lb. of feed: 2.5 mg. riboflavin, 1,135 I.U. vitamin A, 1,360 I.C.U. vitamin D-3 and 0.08 gms. Mn SO_4.

[2] Supplied per lb. of feed: 2.5 mg. riboflavin, 3 mg. calcium pantothenate, 5 mg. niacin, 3 Mcg. vitamin B-12, 1,135 I.U. vitamin A, 1,360 I.C.U. vitamin D-3, and 0.08 gms. Mn SO_4.

[3] Calculation of productive energy based on Fraps (1946).

the end of the sixth and ninth months of production in the second experiment, and at the termination of the third experiment.

All data reported in this paper were analyzed by use of Analysis of Variance according to Snedecor (1946).

RESULTS AND DISCUSSION

Experiment I—The hens which were fed the high-energy diet had a higher rate of egg production (Table II) than did the hens which were fed the low energy diet. This difference was found to be highly significant. The effect of the two diets on percent egg production is shown, by months, in Figure 1. It may be noted that the high energy diet supported a higher rate of production throughout the year than did the low energy diet. The difference in rate of production on these diets tended to decrease during July and August. However, this change in rate of production was not significant since upon statistical analysis the interaction of months x diets was found to be non-significant. A highly significant difference between energy levels was found when comparing feed required to produce a dozen eggs (Table II).

Experiment II—This test was a duplication of Experiment 1, except that the level of some of the B-vitamins was increased and the amount of salt was decreased in the basal diet. The birds fed

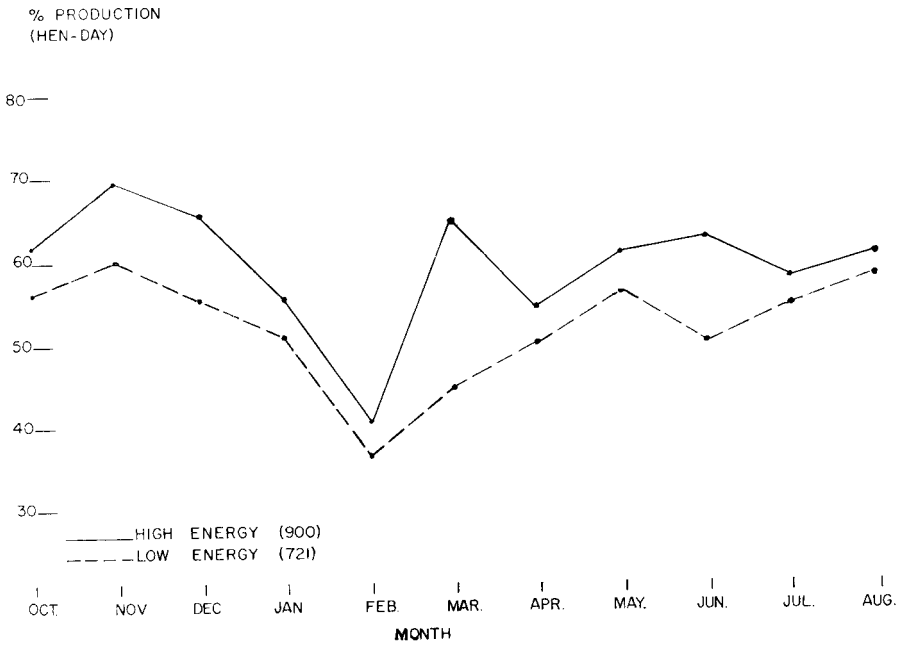

Figure 1.—Effect of dietary productive energy level on percent egg production of Single Comb White Leghorn hens. (Experiment I, 1954-55).

Table II—Effect of Energy Level in the Diet of Single Comb White Leghorn Hens Upon Rate of Egg Production and Feed Efficiency (Experiment I, 1954-55)[1]

Diet	Rate of egg production (percent)	Feed/doz. eggs (pounds)
Low Energy (1954-55)	50.8	6.20
High Energy (1954-55)	58.7*	5.39*

[1] Experimental period October 1 through September 30.
* Significant at the 1 percent level of probability.

the high energy diet laid more eggs per hen than did those receiving the low energy diet. Over the nine month period the rate of egg production for the birds fed on the high energy feed was 61.9 percent, compared to 55.9 percent for the birds fed the low energy feed. This difference, while not as great as that obtained in the first experiment, was highly significant. The effect of the energy level in the feed on percent egg production is shown in Figure 2.

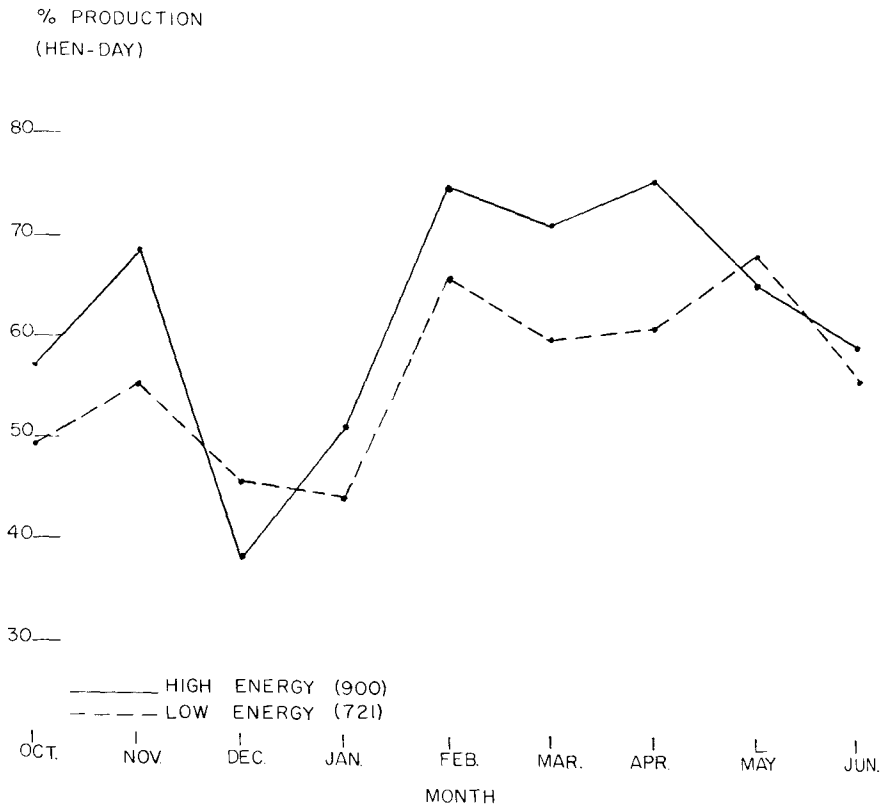

Figure 2—Effect of dietary productive energy on percent egg production of Single Comb White Leghorn Hens (Experiment II, 1955-56).

The trend observed in this experiment was essentially the same as in the first experiment. The high energy diet supported greater egg production throughout the year, but the difference in egg production of the two groups of hens tended to decrease with the onset of warm weather. The poor performance shown in December by the hens receiving the high energy diet was attributed to an improperly functioning automatic waterer in one pen which delivered insufficient water to care for the needs of the birds.

When the feed efficiency of the two groups was compared (Table II) it was found that more feed was needed to produce a dozen eggs when the low energy feed was used, and less feed per dozen eggs was needed when the high energy diet was employed. This finding is in agreement with results of Experiment I. It should be pointed out that four cockerels were kept in each of these pens during four months of the laying period; therefore, since no correction was made for the feed consumed by the males, the feed consumed per dozen eggs is increased.

All birds were individually weighed at the end of the sixth (March) and ninth (June) months of production. The birds on the high energy feed were found to be significantly heavier at the end of the sixth month of production and a highly significant difference was found to exist in body weight at the end of the ninth month of production. No difference could be detected when comparing the mortality of hens receiving these two experimental feeds. Egg size (oz./doz.) was obtained, for a three-day period, at the end of the ninth month of production and no significant difference could be found between egg size from the two groups of hens.

Experiment III—Results of feeding the high and low energy feeds to heavier breed hens are summarized in Table IV. Again it was found that the high energy diets supported a significantly higher rate of egg production than did the low energy diet. The percent egg production of the hens receiving the high energy feed (Figure 3) was consistently above the percent of production obtained from hens fed the low energy diet. Significantly less feed was required to produce a dozen eggs (Table III) with the high energy feed. At the end of the eighth month of production the birds receiving the low energy feed had an average weight of 6.47 pounds as compared to 6.70 pounds for the birds receiving high energy feed. This difference was found to be highly significant.

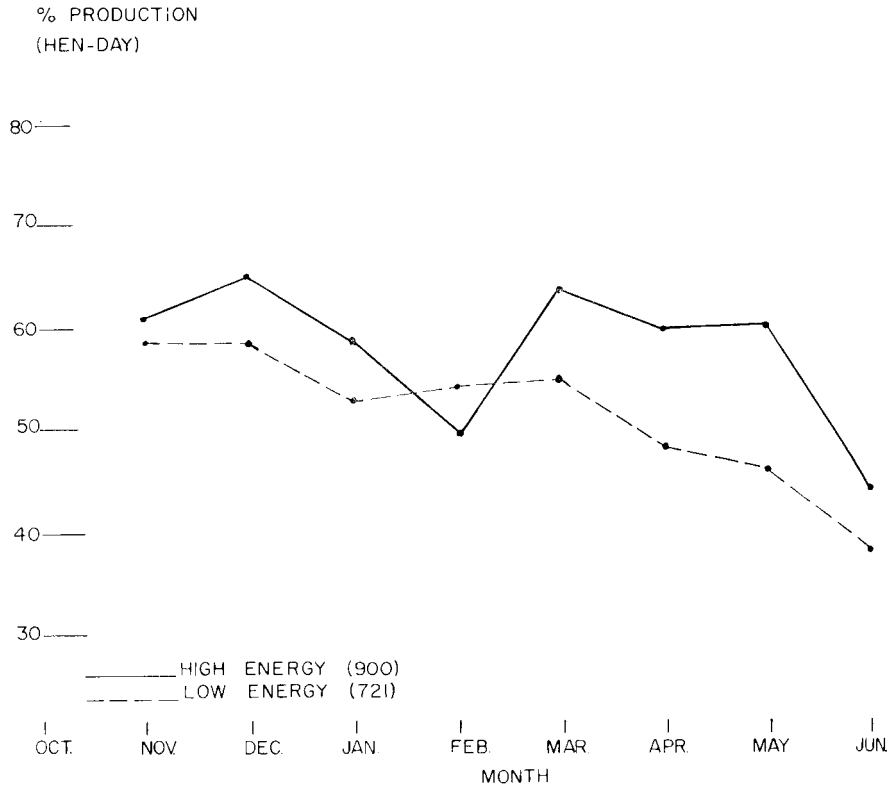

Figure 3—Effect of dietary productive energy level on percent egg production of heavy breed hens (Experiment III, 1955-56).

Table III—Effect of Energy Level in the Diet of Single Comb White Leghorn Hens Upon Rate of Egg Production, Feed Efficiency, Body Weight, Mortality and Egg Size (Experiment II, 1955-56)[1]

Diet	Rate of egg production (percent)	Feed/Doz. egg (2) (pounds)	Av. body wt. at end of 6th mo. prod. (pounds)	Av. body wt. at end of 9th mo. prod. (pounds)	Mortality (percent)	Egg Size end of 9th mo. (oz./doz.)
Low energy (1955-56)	55.9	6.18	4.18	4.14	14.0	25.6
High energy (1955-56)	61.9**	5.60**	4.35*	4.40**	16.0	25.9

[1] Experimental period October 1 through June 30.
[2] Four cockerels kept in each pen from December 1 through March 30.
* Significant at the 5 percent level of probability.
** Significant at the 1 percent level of probability.

Table IV—Effect of Energy Level in the Diet of Heavy Breed Hens Upon Rate of Egg Production, Feed Efficiency, Body Weight and Mortality (Experiment III, 1955-56)[1]

Diet	Breed	Rate of egg production (percent)	Feed/doz. eggs[2] (pounds)	Av. wt. at end of 8th mo. prod. (pounds)	Mortality (percent)
Low energy (1955-56)	New Hampshire	48.5	9.01	6.63	12.0
	White Plymouth Rock	53.5	8.71	6.31	4.8
	Combined	51.0	8.86	6.47	8.7
High energy (1955-56)	New Hampshire	56	7.52	6.79	4.0
	White Plymouth Rock	58.1	7.07	6.60	14.3
	Combined	57	7.29*	6.70**	8.7

[1] Experimental period November 1 to June 30.
[2] Four cockerels kept in each pen from December 1 to March 30.
* Significant at the 5 percent level of probability.
** Significant at the 1 percent level of probability.

SUMMARY AND CONCLUSIONS

Data have been presented on the performance of 84 White Plymouth Rock, 100 New Hampshire, and 440 Single Comb White Leghorn pullets when fed diets containing 721 and 900 calories of productive energy per pound of feed.

A significant increase in rate of egg production was obtained when the energy content of the laying mash was increased from 721 to 900 calories of productive energy per pound in a mash containing 19.2 percent protein. Although the difference in percent production of hens receiving the high and low energy diets tended to decrease during the spring and early summer months the difference was not statistically significant. In each of the three experiments it required less feed to produce a dozen eggs when the high energy diet was fed than when the low energy diet was fed.

The body weight of hens fed the high energy diets was greater than that of hens fed the low energy diet. This difference was found to exist with all breeds involved i.e., Single Comb White Leghorns, White Plymouth Rocks and New Hampshires.

It is concluded that a greater annual rate of egg production and fewer pounds of feed required to produce a dozen eggs should result when a high level of energy per pound of feed is incorporated into a diet containing a high level of protein (19 percent).

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