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Feeding Systems for Laying Hens

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Feeding Systems for Laying Hens
By MACK O. NORTH

Many varieties of poultry feeding trials have been reported by experimental workers, but very few feeding systems have been investigated. Card (1926)* found no significant differences between two systems of feeding: (1) mash self-fed, grain hand-fed in the litter night and morning; (2) mash self-fed, grain hand-fed in boxes night and morning; (3) grain and mash ground together and all self-fed gave slightly inferior results.

Tomhave and Mumford (1931) fed twenty-one feed ingredients in separate containers and compared the results with those from a pen receiving an all-mash ration. This comparison showed that the Leghorn hens did not have the ability or natural instinct to select the proper proportions of the different feeds. In this experiment the proportions of the several constituents were not varied according to changes in production. The authors concluded that "Man can make a more intelligent selection of feeds for the needs of a producing hen than she is capable of doing herself."

Graham (1934) self-fed whole corn, whole oats, and a well-balanced mash to hens individually. He found a wide variation in the intake by different birds, both between hens and from day to day for the same hen. Some required 12 to 13 per cent protein, others 14 to 15 per cent. Habit seemed to play a part in the diet of these hens. He concluded that "These results . . . . indicate that nutritional requirements are governed by an urge of the organism."

Lunn, Fox, and Knowlton (1932) reported a preliminary study which showed no significant differences in mortality, increase in body weights or size of eggs when hens were fed in the following four ways: (1) mash self-fed in hoppers; (2) grain self-fed in hoppers; (3) pellets self-fed in hoppers; and (4) all-mash ration self-fed in hoppers. Method 1 gave the highest egg production and method 3 the lowest. Davidson (1936) reported satisfactory egg production when corn and oats were hopper-fed in conjunction with a self-fed, 20 per cent protein mash.

*More complete citations are given in the bibliography at the end of the bulletin.
Hüber and Liebscher (1936) found a greater consumption of corn than mash when the hens had a free selection, although production was the same in the self-fed and rationed lots. Fangauf and Haensel (1936) reported similar results on relative mash and grain consumption when the grain as well as the mash was self-fed. Similarly again, egg production was not different.

In order to study the practicability of various methods of feeding the same ration this three-year study was undertaken.

**EXPERIMENTAL**

**Procedure**

The hens used in these experiments were Single Comb White Leghorns from the station flock. They were from pedigreed birds and were very similar in breeding. They were range-reared and fed a mash ration during their growing period which consisted of:

- Ground yellow corn ............. 40 pounds
- Ground heavy barley .......... 10 pounds
- Mill run bran ................. 25 pounds
- Meat and bone meal .......... 18 pounds
- Dehydrated alfalfa leaf meal ... 3 pounds
- Chick sized oyster shell ....... 3 pounds
- Salt ................................ ½ pound
- Cod liver oil (400 U.S.P. units per gram) (for the first 8 weeks only) ............. ½ pound

99 ½ pounds

At 12 weeks of age whole wheat was added to the ration and the chicks were fed in the evening all that they would eat in 30 minutes from open troughs. Whole yellow corn was mixed with the wheat when the chicks were 16 weeks of age and the amount increased until two parts of wheat and three parts of corn were being fed.

When approximately 5 per cent of the pullets were laying on the range, they were removed and distributed in the experimental laying pens as uniformly as possible according to weight, maturity, and age.
The birds were confined in a straw-loft house in pens which were 10 feet wide and 20 feet deep. An average of 43 birds per pen was used each year. The pens were equipped with roosts, dropping boards, trap nests, bucket type waterers, open grill-top feeders, and oyster shell hoppers. When the grain was not self-fed, it was fed in small troughs and not in the litter. At the time the birds were placed in the experimental pens, they were changed immediately from the growing ration to the experimental laying ration. Fresh mash was supplied daily. The grain feeding will be described later. Oyster shell and water were available at all times. Straw was used for litter. A small amount of mangels was fed during the four winter months, November, December, January, and February. From November 1 to March 31, a sixty-watt light was on from 5 a.m. until daylight, and was again turned on in the late afternoon, dimmed at 5:45 p.m. and turned off at 6 p.m. The pens were not heated.

**Rations**

The following mash was used in these experiments:

- Ground heavy barley .............. 40 pounds
- Mill run bran .................. 25 pounds
- Wheat gray shorts .............. 10 pounds
- Dried buttermilk ................ 3 pounds
- Meat and bone meal............. 17 pounds
- Dehydrated alfalfa leaf meal... 5 pounds
- Salt ................................ 1 pound
- Cod liver oil (400 U.S.P. units per gram) (used until May 15) ½ pound

\[ \text{Total: } 101\frac{1}{2} \text{ pounds} \]

In conjunction with the mash the following grain mixture was fed:

- Whole yellow corn ................. 60 pounds
- Whole hard winter wheat........... 40 pounds

Oyster shell was available at all times. The methods of feeding the grain are given in Table I.
<table>
<thead>
<tr>
<th>Pen No.</th>
<th>System of mash feeding</th>
<th>System of grain feeding</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Self-fed all day</td>
<td>Hand-fed</td>
<td>The mash was before the birds at all times, but the grain was hand-fed in troughs both morning and evening. One-third of the grain was fed in the morning and two-thirds in the evening.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>½ in morning</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>½ in evening</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Self-fed all day</td>
<td>Hand-fed in the evening</td>
<td>The mash was self-fed all day. All the grain that the birds would consume in 30 minutes was fed in troughs in the late afternoon.</td>
</tr>
<tr>
<td>3</td>
<td>Self-fed all day</td>
<td>Self-fed all afternoon</td>
<td>The birds had mash before them at all times and grain before them all afternoon in open hoppers.</td>
</tr>
<tr>
<td>4</td>
<td>Self-fed all day</td>
<td>Hand-fed in the morning</td>
<td>The mash was self-fed all day, and the grain was hand-fed in the morning only. All the grain which could be consumed in 30 minutes was fed in small troughs early in the morning.</td>
</tr>
<tr>
<td>5</td>
<td>Self-fed all day</td>
<td>Self-fed all day</td>
<td>Both mash and grain were before the birds at all times. They could eat as much as they liked.</td>
</tr>
<tr>
<td>6</td>
<td>All-mash self-fed all day</td>
<td>No whole grain fed</td>
<td>The grain was ground and mixed with mash in the proportion: grain, 44.6 pounds; mash, 55.6 pounds. This mixture was before the birds at all times.</td>
</tr>
<tr>
<td>No.</td>
<td>Mash</td>
<td>Grain</td>
<td>Year</td>
</tr>
<tr>
<td>-----</td>
<td>----------</td>
<td>----------------</td>
<td>--------</td>
</tr>
<tr>
<td>1</td>
<td>Self-fed</td>
<td>Hand-fed</td>
<td>1934-35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in morning</td>
<td>1935-36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% in evening</td>
<td>1936-37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Self-fed</td>
<td>Hand-fed</td>
<td>1934-35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in evening</td>
<td>1935-36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% in evening</td>
<td>1936-37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>all afternoon</td>
<td>1935-36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% in evening</td>
<td>1936-37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Self-fed</td>
<td>Hand-fed</td>
<td>1934-35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in morning</td>
<td>1935-36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% in evening</td>
<td>1936-37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>all day</td>
<td>1935-36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% in evening</td>
<td>1936-37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>All-</td>
<td></td>
<td>1934-35</td>
</tr>
<tr>
<td>mash</td>
<td>self-fed</td>
<td></td>
<td>1935-36</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1936-37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average</td>
<td></td>
</tr>
</tbody>
</table>

* Percentage production by hen days.
† August 1-15 inclusive.
‡ Weighted average.
Egg Production

This test was repeated three times during three laying years, 1934-35, 1935-36, and 1936-37, although it was not possible to test all of the six methods each year. Because the pens in which the birds were kept were not heated, the severity of the cold weather during the winter months caused a drop in egg production. There were few nights during January that the temperature in the laying houses did not drop below freezing.

The summary of egg production in Table II shows that the egg production from the pens was not greatly different and that none of the methods of feeding tested gave consistently the best results. No method gave the best production for all three years, although the all-mash system was the best for two of the three years, and second best the other year.

Egg Weight

During the last year three eggs laid consecutively after the fifteenth of each month beginning with January and continuing through July were weighed from each hen laying. The averages of these weights are given in Table II. The differences in egg weight are not significant. They are not associated with the method of feeding or the speed of production.

Feed Consumption

The total feed consumption of both mash and grain is given in Table III. The total amount of feed consumed per hen did not vary greatly according to the manner in which it was fed. There was only a seven per cent difference in total feed consumption between the lots eating the most and the least feed.

Significant differences were observed in the proportions of mash and grain consumed under the different methods of feeding (Table III). Those lots which had access to grain for a longer period of time consumed a larger amount of grain than mash, while those which had access to grain for a shorter period ate less grain and more mash. Hens fed under system No. 4 ate two-thirds more mash than those under system No. 5. The total feed consumption was approximately the same, however. Under system No. 5, in which both the grain and mash were self-fed all
day, 39.2 per cent of the total feed eaten was mash. When the grain was self-fed in the afternoon only, (system No. 3) 46.8 per cent of the ration was mash. Hand-feeding all the grain either in the morning or evening (systems No. 2 and 4 respectively) limited the time for grain feeding to one quick fill, and consequently more mash had to be consumed to complete the feed requirements. Respectively, 63.9 and 65.8 per cent of their feed was mash. Feeding grain both morning and evening (system No. 1) but restricting the morning grain feeding to about one-half the evening consumption lowered the mash intake to 56.5 per cent of the total feed consumption. The proportions of mash and grain in the all-mash system of feeding (system No. 6) was 55.6 per cent mash and 44.4 per cent grain (ground). These figures were based on mash and grain consumption in previous experiments.

It has been generally thought that high proportions of mash increased the egg production, primarily because the mash contained important constituents necessary for egg production, such as supplementary protein and a large proportion of the vitamins, and that the correct balance of mash and grain should be fed to laying hens. In these trials the proportions of mash and grain consumed under the several systems of feeding were very different yet the egg production showed but a small variation. It is evident from these results that the proportions of grain and mash consumed had no effect on egg production. The lots in which the birds ate a higher proportion of mash did not lay the most eggs, and those in which the birds ate the least mash did not lay the fewest eggs.

The amount of feed required to produce a dozen eggs may be used as an index of the relative merits of the feeding systems. This index is a measure of both egg production and feed consumption. The all-mash system (Table III) took 5.13 pounds of feed to produce a dozen eggs, the least of any.

The cost of the feed necessary to produce a dozen eggs is given in Table III. The figure for the different systems varies not only because of differences in the amount of feed consumed to produce a dozen eggs but also because of differences in the
Fig. 1. Systems of feeding in relation to egg production and feed consumption.
proportions of mash and grain consumed, since the mash usually costs about 50 per cent more than the grain. The cost of 10.7 cents for the all-mash method (system No. 6) was one and one-half cents less than hand-feeding the grain in the morning (system No. 4). The cost of feed per dozen eggs for the other systems was very similar varying between 11.0 and 11.3 cents per dozen.

Although the relative proportions of mash and grain varied according to the method of feeding and these variations did not influence the annual egg production, there was a close correlation between monthly mash consumption and monthly egg production (See Figure 1). The production curves closely follow the mash consumption curves. When production was increasing in the fall, mash consumption increased; and during the cold months when production dropped, the birds ate correspondingly less mash. These curves are so consistent that the ample consumption of mash seems very important in any system of feeding. Important too, was the fact that the consumption of grain was practically constant regardless of the rate of production or the system of feeding. During periods of cold weather, the birds did not eat more grain; the only change was a decrease in mash consumption.

The all-mash system of feeding forced the hens to eat mash and grain (the grain was ground and added to the regular mash) in the same proportions throughout the year. The birds ate a larger proportion of mash during the winter months because they had no alternative. Evidently this was responsible for the larger number of eggs this system produced for the production curve was more nearly level.

**Body Weight**

Table III gives the gain in body weight of the pullets. No differences were noted in the gains or in the visual condition of the birds during the three trials. Varying proportions of mash and grain were consumed under the different systems of feeding, yet this had no altering effect on body weight.
<table>
<thead>
<tr>
<th>System of feeding</th>
<th>Feed consumed per 100 hens per day</th>
<th>Percentage of production</th>
<th>LDS. feed required to produce 10 dozen eggs</th>
<th>Percentage mortality</th>
<th>Percentage of weight gain in body</th>
<th>Percentage of fertile eggs hatched</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mash lbs. Grain lbs. Total lbs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Self-fed all day</td>
<td>9.91 8.23 18.14</td>
<td>5.10</td>
<td>24</td>
<td>19.9</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>1 Self-fed all day</td>
<td>12.57 10.59 23.46</td>
<td>5.63</td>
<td>28</td>
<td>27.9</td>
<td>97.7</td>
<td>68.3</td>
</tr>
<tr>
<td>1 Self-fed all day</td>
<td>12.50 8.30 20.80</td>
<td>5.66</td>
<td>12</td>
<td>12.9</td>
<td>89.6</td>
<td>61.9</td>
</tr>
<tr>
<td>1 Self-fed all day</td>
<td>Average 11.76 9.04 20.80</td>
<td>56.5</td>
<td>45.6</td>
<td>5.46</td>
<td>11.1c</td>
<td>21.3</td>
</tr>
<tr>
<td>2 Self-fed all day</td>
<td>10.46 6.90 17.36</td>
<td>5.36</td>
<td>30</td>
<td>14.8</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>2 Self-fed all day</td>
<td>13.30 7.65 20.95</td>
<td>5.24</td>
<td>22</td>
<td>18.2</td>
<td>94.1</td>
<td>66.0</td>
</tr>
<tr>
<td>2 Self-fed all day</td>
<td>13.92 6.74 20.66</td>
<td>5.65</td>
<td>25</td>
<td>19.3</td>
<td>89.6</td>
<td>67.6</td>
</tr>
<tr>
<td>2 Self-fed all day</td>
<td>Average 12.56 7.10 19.66</td>
<td>63.9</td>
<td>43.6</td>
<td>5.42</td>
<td>11.3c</td>
<td>25.7</td>
</tr>
<tr>
<td>3 Self-fed all day</td>
<td>9.70 9.92 19.62</td>
<td>5.90</td>
<td>26</td>
<td>14.3</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>3 Self-fed all day</td>
<td>9.95 11.45 21.40</td>
<td>5.41</td>
<td>25</td>
<td>19.1</td>
<td>94.0</td>
<td>76.1</td>
</tr>
<tr>
<td>3 Self-fed all day</td>
<td>Average 9.38 10.69 20.06</td>
<td>46.8</td>
<td>42.7</td>
<td>5.66</td>
<td>11.0c</td>
<td>25.5</td>
</tr>
<tr>
<td>4 Self-fed all day</td>
<td>13.94 7.24 21.18</td>
<td>43.7</td>
<td>5.82</td>
<td>12.2c</td>
<td>24.0</td>
<td>18.2</td>
</tr>
<tr>
<td>4 Self-fed all day</td>
<td>Average 13.94 7.24 21.18</td>
<td>65.8</td>
<td>43.7</td>
<td>5.82</td>
<td>12.2c</td>
<td>24.0</td>
</tr>
<tr>
<td>5 Self-fed all day</td>
<td>8.44 11.11 19.55</td>
<td>6.57</td>
<td>36</td>
<td>19.1</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>5 Self-fed all day</td>
<td>8.04 15.21 23.25</td>
<td>5.71</td>
<td>25</td>
<td>26.1</td>
<td>94.9</td>
<td>63.9</td>
</tr>
<tr>
<td>5 Self-fed all day</td>
<td>8.10 12.22 20.32</td>
<td>5.35</td>
<td>16</td>
<td>19.0</td>
<td>91.9</td>
<td>74.5</td>
</tr>
<tr>
<td>5 Self-fed all day</td>
<td>Average 8.19 12.85 21.04</td>
<td>39.2</td>
<td>43.4</td>
<td>5.88</td>
<td>11.1c</td>
<td>25.7</td>
</tr>
<tr>
<td>6 Self-fed all day</td>
<td>18.45 18.45</td>
<td>5.03</td>
<td>33</td>
<td>15.0</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>6 Self-fed all day</td>
<td>21.70 21.70</td>
<td>5.27</td>
<td>22</td>
<td>28.3</td>
<td>96.1</td>
<td>61.3</td>
</tr>
<tr>
<td>6 Self-fed all day</td>
<td>19.83 19.83</td>
<td>5.08</td>
<td>17</td>
<td>13.3</td>
<td>93.7</td>
<td>65.7</td>
</tr>
<tr>
<td>6 Self-fed all day</td>
<td>Average 19.99 19.99</td>
<td>55.6</td>
<td>46.6</td>
<td>5.13</td>
<td>10.7c</td>
<td>24.0</td>
</tr>
</tbody>
</table>

*44.4 pounds of grain were ground and mixed with 55.6 pounds of mash and fed as an all-mash ration. This ratio was used because previous work showed this was the approximate ratio consumed when system No. 2 above was fed (Bul. 203, 1934, Wyo. Agri. Exp. Sta., p. 34).

†The mash was valued at $2.35 per cwt., and the grain at $1.60 per cwt. An additional 15 cents per cwt. for grinding and handling the grain that was mixed with the mash was added to the cost of the grain for system No. 6.

**Mortality**

There were no significant differences in mortality (Table III). Where there is an average of 43 birds per pen, the death of two or three additional birds may result in quite a difference in percentage, and still not be significant. Most of the mortality during the three years was from roup and associated diseases. There
was no indication, however, that the incidence of roup was due to the feed or to the system of feeding.

**Hatchability**

Data on hatchability were collected during the last two years (Table III). Three males were kept in each pen during the breeding season and about 450 eggs were incubated from each pen each year during March and April. The males were rotated among the pens so that hereditary differences among the males would not influence the results.

The fertility under the several systems was very similar. Each year differences in hatchability were obvious, but these differences were not consistent for the two years so they were probably not significant. It is interesting to note, however, that there seemed to be a slight relationship between high production during the hatching season and low hatchability, and between low production and high hatchability.

**DISCUSSION**

The all-mash system of feeding gave the best results over a three-year period. It was evident that the consumption of mash was the deciding factor in egg production rather than the proportions of mash and grain. The latter seemed to have no influence although there was a wide variation in the different methods of feeding. It would seem practical with any system of feeding to give special attention to keeping the mash consumption at a high level because of its obvious importance in promoting production. Feeding a small amount of moist mash once daily when production shows a drop might be effective in forcing the birds to eat a normal amount of mash.

It must be remembered that all of the birds were raised to maturity on both grain and mash. The mash was self-fed and the grain was hand-fed in the evening, similar to system No. 2. The change to the various systems of feeding was made when the birds were placed in the laying house, and the change was sudden. Naturally, those systems having a constant supply of grain gave the birds an opportunity to consume extraordinarily large amounts
of grain at first, but even this did not cause any postponement of egg production. This heavy grain consumption gradually decreased so that in about two weeks the grain consumption dropped to normal for the method of feeding.

Any of these systems of self-feeding should give good results so far as egg production is concerned. The item of cost is important, however, and it should be remembered that there is the additional cost of grinding the grain when it is mixed with the mash for the all-mash system of feeding. This oftentimes necessitates quite an expenditure when the grain must be hauled to the mill, ground, and again hauled to the farm. Fifteen cents a hundred pounds was added to the cost of the grain in the all-mash system of feeding to allow for the cost of grinding. The cost may be greater in many cases. Because of the varying conditions found on poultry farms, individual requirements will determine the method of feeding to use.

SUMMARY

Six methods of feeding laying hens the same ration were tested over a three-year period. They were: (1) mash self-fed, \( \frac{1}{2} \) grain hand-fed in morning, \( \frac{1}{2} \) hand-fed in evening; (2) mash self-fed, all grain hand-fed in the evening; (3) mash self-fed, grain self-fed in the afternoon; (4) mash self-fed, all grain hand-fed in the morning; (5) mash self-fed, grain self-fed all day; and (6) an all-mash ration self-fed all day.

The all-mash system of feeding hens for egg production gave slightly the best results over a three-year period. The five other methods of feeding produced results similar to each other.

There were no significant differences between the systems of feeding in egg weight, mortality, gain in body weight, fertility, or hatchability.

The cost of feed per dozen eggs was lowest for the all-mash system of feeding and highest when the grain was hand-fed early in the morning. The other systems were similar to each other in feed cost per dozen eggs.

The experimental results indicate that any of the systems tested may be satisfactorily used for feeding laying hens.
BIBLIOGRAPHY


