5-1957

Feeding Systems for Layers

C. W. Carlson
South Dakota State University

W. Kohlmeyer
South Dakota State University

W. C. Morgan

CIRCULAR 138 MAY 1957

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POULTRY DEPARTMENT
AGRICULTURAL EXPERIMENT STATION
SOUTH DAKOTA STATE COLLEGE, BROOKINGS

SUMMARY

Three feeding systems—all-mash, 20 percent protein mash with free-choice grain, and 26 percent protein mash with free-choice grain—gave equally good performance in two experiments with heavy-type hens. In a third experiment, the all-mash system was superior in bringing about higher egg production and improved feed efficiency.

The kind of care a poultryman gives his flock is usually the factor that determines which feeding system is best for his layers. If he gives his flock proper care, a 20 percent protein mash and free-choice grain system may give good results.

Although mash consumption varied from 37 to 53 percent, a 20 percent mash and free-choice grain system gave production rates of 55 to 70 percent with various groups of layers. Mash intake did not necessarily increase when production was better.

A 25-27 percent protein mash and free-choice grain feeding system may be the safest free-choice grain feeding system to use. Theoretically, it could provide a more adequate protein intake.

Results of the experiments reported in this circular may not be applicable to other types of laying hens or those laying at different rates or under different conditions.

Since there is a disagreement on protein requirements and since the interrelationships between proteins and various nutrients present problems, further research should be done.

Feeding Systems for Layers

C. W. Carlson, Wm. Kohlmeyer, and W. C. Morgan[1]

Numerous reports show there are many feeding systems for layers that the poultryman will find satisfactory. The important factor for good results is proper management of the feeding system.

Essentially the most common feeding systems recommended and in use today are (1) all-mash, (2) 18-20 percent protein mash with limited or free-choice grain, and (3) 25-27 percent protein concentrate with free-choice grain.

Some poultrymen have reported successful use of a 32 percent protein concentrate fed free-choice with grains. The laying hen has a remarkable ability to balance her own ration, but it has generally been felt that more concentrate is consumed than necessary when a 32 percent protein concentrate is used.

Before poultrymen started to use high energy feeds, all-mash rations were considered somewhat low in energy for maximum egg production—particularly during the winter. High energy all-mash diets should supply the extra energy needed for maintenance under cold weather conditions and therefore support production equal to that of the other systems. Many field reports indicate that some all-mash diets today are giving better results than the various mash and grain feeding systems.

Here are some of the reasons poultrymen have again become interested in all-mash diets.

1) Bulk handling of feed has greater application where all-mash diets are used. Bulk handling of feed, in itself, appeals to many because of price discounts and the economy of handling costs.

2) All-mash feeds are more adaptable for use in mechanical feeders and cage-feeding operations.

3) Use of fats and oils in feeds to increase energy content finds greater application in all-mash feeds.

[1]Dr. Carlson is poultryman, Mr. Kohlmeyer is poultryman and head of the Poultry Department, and Dr. Morgan is associate poultryman, South Dakota State College Agricultural Experiment Station.

The data in this circular were obtained from three experiments with heavy-type hens in which three feeding systems were compared. Also data obtained from use of a 20 percent protein mash and free-choice grain feeding system with various groups of layers are presented.

EXPERIMENTAL

The experiments were conducted during 3 successive years in 12- x 20-foot pens located in the north wing of a cold-wall type laying house. Straw was used for litter and replaced as deemed necessary.

For the three experiments, succeeding generations of the New Hampshire or White Plymouth Rock stock from the station flocks were used. Pullets were moved from the range and were randomly assorted into pens, 60 per pen, when they were about ready to start egg production. No culling was practiced in these experiments. After approximately 2 months of egg production they were placed on the experimental diets. The changeover from the regular 20 percent protein mash and free-choice grain diet was abrupt.

The formulae for the various experimental diets used are shown in table 1. Granite grit, oyster shells, and water were made available to the birds at all times. The 20 percent protein mash and grain were fed on a free-choice basis, since

Table 1. Formulae* of Mashes Used in the Experiments With Various Feeding Systems

Ingredients	Percent Protein in the Mash					
	Experiments 1 and 2			Experiment 3		
	15%†	20%‡	26%‡	15%†	20%§	26%§
	(% of Ingredient in Ration)					
Ground Yellow Corn	43.5	20	—	66	32	10
Wheat Bran	10	20	30	5	10	15
Wheat Mids	10	20	26.5	5	10	15
Ground Oats	22	11	—	5	10	3
Alfalfa Meal	2	4	6	2	4	6
Meat Scraps	6	12	18	5	10	15
Soybean Meal	3.5	7	10.5	5	10	15
Fish Meal	1	2	3	2	4	6
Dried Buttermilk	1	2	3	2	4	6
Steamed Bonemeal	—	—	—	2	4	6
Salt Mix**	0.5	1	1.5	0.5	1	1.5
Vitamin Supplement††	0.5	1	1.5	0.5	1	1.5

*Oyster shells and granite grit available free-choice.
†Fed as all-mash.
‡Fed with free-choice access to mash and mixed grain, 3 parts corn to 1 part oats by weight.
§Fed with free-choice access to mash and grain, corn and oats in separate hoppers.
**2½% manganese sulfate in iodized salt.
††When used at the ½% level this supplied per pound: 0.6 mg. riboflavin, 1,800 I.U. Vitamin A, and 625 I.C.U. Vitamin D.

that has been a common practice in certain areas.

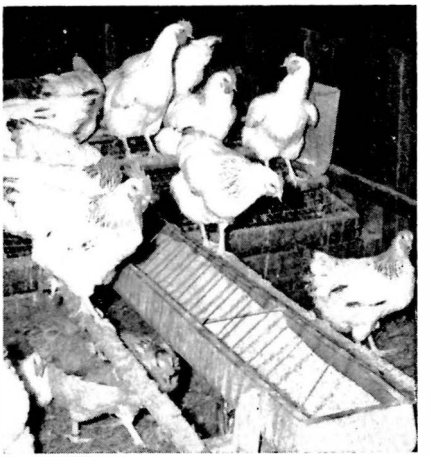
Data were obtained for egg production, feed consumption, body weight changes, and mortality for a 7-month period—December through June—in each experiment.

RESULTS AND DISCUSSION

The rate of egg production obtained with the three systems of feeding did not differ appreciably for the first two experiments, as shown in table 2. Satisfactory production was obtained with the 20 percent protein mash and free-choice grain system.

Although feed efficiency with this system was poorest (see table 3) the actual feed cost per dozen eggs with this system (see table 5) was less in Experiment 1 and intermediate in Experiment 2. The reason for this apparent discrepancy lies in the relative amounts of mash and grain intake shown in table 4.

To be adequate, particularly from the protein standpoint, the 20 percent protein mash and grain systems should include equal proportions by weight of mash and grain to make up 96 percent of the total feed. This allows for consumption of about 4 percent oyster shells, which is indicated by the figures for mash consumption on the all-mash diet. As has been experienced in the field when 20 percent protein mash is fed free-choice with large amounts of corn, grain consumption exceeded 48 percent. However, production with the 20 percent protein mash and grain system was maintained at an acceptable rate



A pen of layers receiving mash and grain free-choice.

Table 2. Effects of Different Feeding Systems Upon Egg Production (7 Months—December through June, 1955-56)

Exp. No.	Breeds*	Percent Egg Production (Hen Day)		
		15% Protein All-Mash	20% Protein Mash & Grain	26% Protein Mash & Grain
1	N. H.	51.0	49.2	48.8
2	W. P. R.	48.4	47.9	49.8
3	W. P. R.	—	41.6†	42.8†
3	N. H.	49.3†	—	44.6†

*Symbols for breeds: N. H.—New Hampshire, W. P. R.—White Plymouth Rock.
†Average of two replications.

for these strains of New Hampshire and White Plymouth Rocks and was comparable to the other diets which theoretically should have been more adequate.

NUTRIENT INTAKE

A consideration of actual nutrient intake on the 20 percent protein mash and grain system reveals that all of the known essential nutrients required for egg production, except protein, were supplied at levels near or in excess of the requirements. The National Research Council has set the protein requirement for laying hens at 15 percent. On the other hand, the relative

Table 3. Effects of Feeding Systems on Feed Efficiency

Exp. No.	Breed*	Lbs. Feed/Doz. Eggs 15% Protein All-Mash	20% Protein Mash & Grain	26% Protein Mash & Grain
1	N. H.	7.9	8.4	8.2
2	W. P. R.	9.3	9.6	8.9
3	W. P. R.		10.0	9.8
3	N. H.	7.7		9.0

*Symbols for breeds: N. H.—New Hampshire, W. P. R.—White Plymouth Rock.

Table 4. Percentage Mash Consumption on Various Feeding Systems

Exp. No.	Breed*	15% Protein All-Mash†	20% Protein Mash & Grain	26% Protein Mash & Grain
		%	%	%
1	N. H.	95.6	31.5	28.7
2	W. P. R.	97.1	38.8	30.7
3	W. P. R.		35.7	35.9
3	N. H.	96.2		33.9

*Symbols for breeds: N. H.—New Hampshire, W. P. R.—White Plymouth Rock.
†Balance to 100% was oyster shells.

Table 5. Feed Cost on Various Feeding Systems

Exp. No.	Breed*	Cents per Dozen Eggs 15% Protein All-Mash ($2.83/cwt.)†	20% Protein Mash & Grain ($3.26 & $2/cwt.)†	26% Protein Mash & Grain ($3.79 & $2/cwt.)†
1	N. H.	21.8	19.2	20.3
2	W. P. R.	25.9	23.6	22.4
3	W. P. R.		24.0	25.6
3	N. H.	21.3		23.1

*Symbols for breeds: N. H.—New Hampshire, W. P. R.—White Plymouth Rock.
†Cost of mash and grain, respectively.

amount of protein intake with the 20 percent mash-grain system in the first experiment was only about 12.7 percent. Data from this station as well as from several others (including Wisconsin, Colorado, and the USDA Agricultural Research Service) indicate that the 15 percent figure is too high. Protein levels as low as 11-12 percent have supported good egg production but have resulted in poorer feed efficiency. Generally 14 percent protein has supported good feed efficiency as well as good egg production.

Although this work was not designed to determine protein requirements, calculations from the data of Experiments 1 and 2 also show that heavy-type laying hens do not need 15 percent protein for egg production. A factor which should not be overlooked, however, is that the 15 percent protein all-mash diets used in Experiments 1 and 2 were relatively low in energy content and that the 20 and 26 percent protein mashes were proportionally lower in energy content.

The diets used in Experiment 3 were more typical of the high energy laying rations in use today. They contain little or no oats or wheat by-products or other such low energy ingredients. Neither of the mash and grain diets used in Experiment 3 permitted as good performance as the all-mash diet.

It is difficult to explain why the production rates on the mash and grain feeding systems were relatively poorer in Experiment 3 than in the previous experiments. Relative disease level was probably not any greater for this experiment than for the earlier ones, since response to high levels of antibiotics fed to hens in the same house was just as great during the time Experiment 1 was conducted as during that of Experiment 3. One possible explanation is that by increasing the energy content of the diets, total feed intake was decreased. This reduced intake may have reduced the supply of certain critical nutrients, especially with the 20 percent protein mash and grain system. However, production and feed efficiency with the 26 percent protein mash and grain system was not

An all-mash diet is essential in a modern caged layer feeding operation.

much better than that obtained with the 20 percent protein mash and grain system.

COMPARING THE SYSTEMS

Nevertheless, with the changes in diets and methods of grain feeding and with the probable changes in environmental conditions between years, the all-mash diet proved to be the best feeding system in this latter experiment. Production and feed efficiency were superior to that obtained on the mash and grain diets. On the other hand, it would appear that the calculated differences in feed costs between the all-mash system and the 20 percent protein mash and grain systems were very small. The actual feed cost per dozen eggs was 1.6 cents less for the 20 percent protein mash and grain system and 1.8 cents less for the all-mash system than for the 26 percent protein mash and grain system. The variations obtained previously did not show consistent differences in feed costs for any of these feeding systems.

Although these data indicated that mash and grain diets may not always bring about as good egg production as can be obtained with all-mash diets, one of the reasons for these differences probably is due to management. Among other things, feeding whole corn and oats separately may have had a detrimental effect in the last experiment. Feeding the corn mixed with some oats may tend to force all hens to eat at least some mash. With separate grains always available, particularly corn, some hens may prefer to eat nothing but grain and thus not be able to perform satisfactorily. When the grains were mixed, the data from the earlier experiments showed that either of the mash and grain systems was as good as the all-mash system.

There were no consistent differences in body weight changes with any of the feeding systems, as is shown in table 6. Hens with free access to grains did not take on excessive body weight. The heavier weight of the hens in Experiment 3 could have influenced their response to the different feeding systems. However, it is not likely, since their weights did not change appreciably over the experimental period.

Although mortality figures are not given, there were no differences consistent with the type of feeding system.

DATA FROM SUBSTATIONS

A summary of data obtained at the three substations of the South Dakota Agricultural Experiment Station on which various groups of laying hens were kept during the 1955-56 season is given in table 7. The mash used for this work was almost identical to the 20 percent protein mash used in Experiment 3, with the exceptions that fish meal was replaced by doubling the level of dried buttermilk, and 4 grams of penicillin was added to each ton of mash.

As can be seen from the data, egg production in several instances was very good with this feeding system—far superior to that obtained in Experiment 3 with this

system and the purebred White Plymouth Rocks.

For this study, oats was either fed alone or with corn. The different types of hens used, including various topcrosses, single crosses, crossbreds, and commercial hybrids, undoubtedly made for a large part of the differences in egg production. Examination of the data shows, however, no apparent correlation between performance and relative mash intake.

It appeared from calculations and actual performances that levels of mash intake as low as 39 percent supplied all of the required nutrients in adequate amounts for good egg production. On the other hand, only the C-2 group, which consumed 53.2 percent mash, could be classified as having good feed effi-

Table 6. Body Weight Index of Hens on Different Feeding Systems

Exp. No.	January Average Body Weight, lbs.			June Weight as a % of January Weight		
	All-Mash	20% Protein Mash & Grain	26% Protein Mash & Grain	All-Mash	20% Protein Mash & Grain	26% Protein Mash & Grain
1	5.1	5.3	5.0	98	99	103
2	5.0	4.9	5.1	102	105	105
3	—	5.9	5.8	—	99	95
3	5.4	—	5.6	100	—	99

Table 7. Use of a 20 Percent Protein Mash and Grain Feeding System With Different Groups of Layers at the Substations (7 Months—December through June, 1955-56)

Group*	Body Wt. (lbs.)	% Production (Hen-Day)	% Mash	Free-Choice Grain	Lbs. Feed/ Doz. Eggs
C-1	6.2	66.1	46.3	oats	5.7
C-2	4.7	67.3	53.2	oats	5.1
C-3	6.7	64.2	44.2	oats	5.9
C-4	6.4	66.5	41.5	oats	5.4
E-1	6.3	54.6	37.3	corn and oats	6.9
E-2	6.2	55.8	45.8	corn and oats	6.6
E-3	4.4	62.5	38.9	corn and oats	5.8
E-4	6.3	57.3	50.3	corn and oats	6.5
H-1	6.0	60.9	41.3	oats	6.4
H-2	6.0	66.3	41.8	oats	6.8
H-3	6.1	69.6	41.6	oats	5.7
H-4	6.2	62.3	40.7	oats	6.6

*Designations of substations: C—Range Field Station at Cottonwood, E—North Central Substation at Eureka, H—Central Substation at Highmore.

ciency for egg production – 5.1 pounds per dozen eggs. Although the two lighter weight groups, C-2 and E-3, performed best at their particular stations, they consumed mash at quite different rates. It is unlikely that they both were consuming mash and grain in a ratio proportional to their actual requirement for nutrients.

These latter data show that hens cannot be relied upon to balance their own nutrient intake for maximum efficiency when they are on a free-choice feeding system. It is quite likely that the C-2 group consumed too much mash and therefore did not produce eggs as economically as possible. On the other hand, the E-3 group probably ate too little mash for best performance. One can only speculate as to whether relative performances of these and the other groups of hens would have varied with a different feeding system.

Serving SOUTH DAKOTA'S *Poultry Industry*

The Poultry Department serves the people of South Dakota in many ways. The services include the following:

Research in Poultry Husbandry. The current research program deals with such problems as breeding methods, marketing, nutritional requirements of chickens and turkeys, performance of chickens in cages, forage crops for turkeys, effects of diet on carcass and egg quality, and mineral requirements of turkeys. This research is revised and brought up to date from time to time. It is intended to provide answers to some of our more pressing poultry problems.

Teaching Resident Students. Most freshman students in the Division of Agriculture take an introductory course in Poultry Production. Advanced courses are offered as electives to students majoring in other departments and are required for students majoring in Poultry Husbandry. Graduate work is available to qualified students.

Extension Service. Results of research are carried to poultry producers, marketing agencies, and hatchery operators through the Extension Service. Development of a profitable industry depends on early adoption and practical use of newer knowledge brought out in research projects.

Advisory Service on Special Problems. This work is handled by Extension specialists and members of the research staff. Sometimes it can be done by correspondence; at other times urgent and immediate need justifies a personal or group conference. This service can be especially useful where a "tailor-made" solution to an important problem is needed.

Related Services by Other Departments. The Poultry Department cooperates with other departments in research and service work on such projects as marketing, diagnostic service, identifying parasite pests and offering suggestions for their control, feed analysis, assistance with farm organization, and technical help on building construction and ventilation. Many of the services are available without charge while nominal fees are charged for some of the services.

The complete program is operated to make poultry production a more profitable business for South Dakota farmers.