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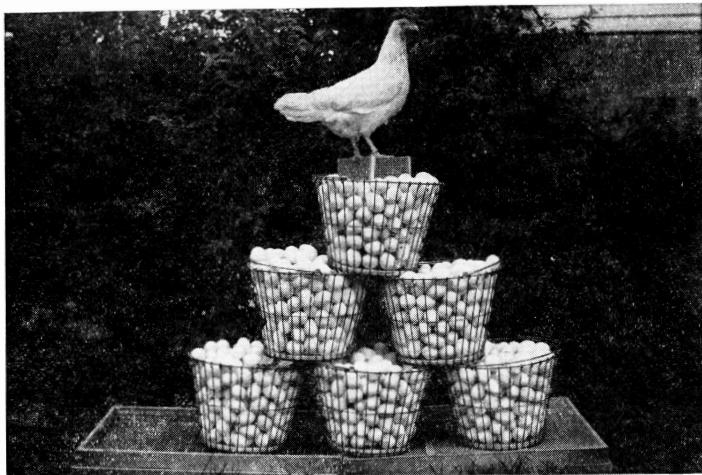
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Feeding for Egg Production

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This hen in the University of Missouri flock, fed in accordance with the recommendations given in this circular, laid a total of 1,016 eggs in five years.

Feed represents much more than half the total cost of egg production. The average well managed flock of 165 hens and the young stock necessary to make normal replacements is fed approximately 7 tons of feed in a year. This represents large volume and quick turn-over in the business of selling feed through the laying flock, yet such an expenditure of feed requires good judgment to insure its being properly selected and proportioned. A study of the records of farmers cooperating with the Missouri College of Agriculture shows that these farmers produce more than two dollars' worth of poultry products for every dollar's worth of feed. A further study reveals that the more liberally fed flocks return the greatest labor income.

To secure best results it is necessary that the hens be fed liberally, that the feed be properly selected, and that it be fed in proper proportions under sanitary and comfortable conditions.

The first principle is to feed liberally. There are two main purposes for which feed is used; first to supply the body needs, and second to make eggs. About 60 per cent of the ration, where liberal feeding is practiced, is required for maintenance; consequently, if the hen receives only 60 per cent of the feed she would eat if given an opportunity, few if any eggs can be produced.

In selecting the feeds for the laying ration the wise flock owner will make the largest practicable use of grains and other feeds produced on the farm, he will supplement these with mill by-products and protein concentrates, he will supply minerals, see that the water supply is adequate and sanitary, provide succulent feeds in season, make sure that his hens have the necessary vitamins, and that the fibre content of the ration is within the digestive limitations of the poultry flock.

It is not enough, however, merely to select feeds wisely and supply them to the flock with a liberal hand; there must be proper balance so that the various nutrients shall be supplied in the proportions best suited to the requirements of body maintenance and egg production. Grains and grain by-products are low in protein; consequently it is necessary to supplement them with protein concentrates, such as meat scrap, or some form of milk.

PROTEIN FEEDS ARE IMPORTANT

At the Missouri Agricultural Experiment Station it has been found that the presence in the ration of any of these animal proteins will increase the number of eggs laid by the hen from 60 to 72 eggs per year, as compared to results from the same ration without the animal food. For each pound of meat scrap or its equivalent in skimmilk an extra dozen eggs was obtained. The cost of feeding the hen was increased slightly while her egg production was practically doubled. Of the vegetable protein concentrates the use of soybean oil meal as a partial substitute for meat scrap or milk is becoming a more general practice.

HENS NEED VITAMINS

Apparently there are conditions under which the problem of poultry feeding is not solved by liberal feeding and by including in the ration the necessary protein concentrates. It is possible that the ration may be deficient in vitamins. While there are a number of these vitamins, the three which apparently demand the attention of the poultryman are vitamins A and D, and G. The others are found in abundance in ordinary poultry rations or are not important to poultry.

The absence of vitamin A in the ration results in poor growth in young chicks and a peculiar eye trouble similar to roup in adult hens. This condition is naturally accompanied with poor egg production. The principal sources of this vitamin are the green leafy parts of plants, yellow corn, yellow carrots, and certain animal fats including egg yolk, butter fat, and fish oils such as cod liver and sardine oil. It is not present in white corn, the white portion of plants, or in most root crops. In fact, most of the common grains such as wheat, oats, milo, and kafir possess little, if any, vitamin A.

The absence of vitamin D in the ration results in failure of the bird to utilize its minerals to advantage. In adult hens this is characterized by poor egg production, soft-shelled eggs, and a paralysis frequently resulting in an egg-bound condition. Exposure to direct sunlight or ultra violet light is equivalent in its effect to feeding vitamin D. The chief feed sources of this vitamin are certain animal fats such as cod liver oil, sardine oil, and egg yolks. At the Missouri Agricultural Experiment Station hens not provided with this vitamin and kept housed behind window glass, which filters out the ultra-violet rays, laid very poorly, averaging about one egg per hen per week. By feeding fish oil or by opening the windows of the house so that the direct sunshine might enter, the production was increased in two weeks to 4 eggs per hen per week.

Vitamin D is normally incorporated in laying rations during the winter months at the rate of one pint or one per cent of standard fish oil per 100 pounds of mash. Standard grades of fish oil contain 85 units of vitamin D per gram. More potent fish oils, commonly referred to as "fortified" oils, having a higher vitamin D content are available. These oils should be used according to the manufacturer's instructions.

Rations supplied to hatchery flocks or to breeding flocks should contain 1% fish oil during the winter and early spring months.

Rations low in Vitamin G or ribo-flavin result in poor growth in baby chicks and low hatchability. Practical sources of this vitamin are green feed and milk products. For this reason rations for baby chicks and for hens producing hatching eggs should contain milk products in some form and green leafy material such as alfalfa leaf meal.

LAYING HENS REQUIRE MINERALS

Aside from salt which should usually constitute one per cent of the mash portion of the ration, the mineral requirements of lay-

ing hens are satisfied when meat scrap or milk is fed, with the exception of shell making material. Soft limestone rock and oyster shell furnish shell-making material. Their comparative values depend upon the analysis of the rock. Limestone rock should run over 95 per cent calcium carbonate and should have an extremely low magnesium content. Shell-making material should be kept before the hens all the time; without it, egg production will be reduced or even completely stopped. It is a mistake to neglect this cheapest of poultry feeds.

WATER IS NECESSARY

Hens must have water, and failure to supply it will greatly decrease egg production. If this important point is neglected the eggs will be reduced not only in number but also in size. Shortage of water may also seriously impair the health of the flock.

A drinking stand, 18 inches high, on which the container may be kept will aid in keeping the water clean. The vessels must be kept clean and in case of outbreaks of colds or other disease the water should be rendered antiseptic.

GRAIN FEEDS

Grain feeds usually constitute from one-half to two-thirds of the total ration for laying hens. The chief point to consider in selecting grains for this purpose is the relative price. It should also be remembered that grains with hulls should not constitute more than one-third of the grain; otherwise the amount of crude fibre will be too great. Where two or more kinds of grain are used it is not necessary to mix them, unless it is more convenient to do so.

THE LAYING MASH

It is common practice to supplement the whole or cracked grains with a mixture of ground feeds referred to as mash. Under average conditions hens should eat at least one-half as much mash as grain, although frequently the proportions are equal.

The feeding of mash, consisting of mill by-products and animal by-products, is the most convenient way of including in the ration those concentrates that are essential to the proper balance of the various nutrients. Other advantages of feeding mash are: its use in hoppers affords a constant supply of feed; mill by-products frequently are cheaper than whole grains; wheat by-products are very valuable in a hen's diet; and there is no danger of hens over-eating on dry mash. Egg production is usually in direct proportion to the amount of mash consumed.

In a mash for laying hens palatability, composition and mechanical make-up are important. To afford proper bulk and to keep the crude fibre within reasonable limits at least one-fourth and not more than one-third of the mash should be bulky material such as bran, bran and alfalfa combined, or ground oats. To afford proper balance of the nutrients at least one-fifth of the mash should be a protein concentrate such as commercial meat scrap or its equivalent. The other ingredients may be shorts, corn meal, or other available ground feeds of similar nature.

Concentrates are sometimes used in combination with grains for poultry feeding. Concentrates usually contain 30 per cent or more protein whereas laying mashes contain 20 per cent. The ratio of grain to concentrate should be about 4 parts of grain to one of the concentrate. The following formula illustrates a concentrate for laying hens.

Dried buttermilk	-----	100 pounds
Soybean oil meal	-----	225
Meat scrap	-----	225
Alfalfa leaf meal	-----	100
Wheat shorts	-----	230
Bran	-----	100
Salt	-----	20
Fish oil	-----	20

A minimum of three whole grains must be separately fed and supplied constantly in hoppers along with the concentrate. These grains should include yellow corn and a choice, depending upon cost and availability, of barley, wheat, oats, and grain sorghums.

SUGGESTED RATIONS

With all of the foregoing requirements in mind the following amounts and proportions are suggested for use in feeding for egg production:

Daily Winter Ration for 100 Hens		
Grain Feed	Mash	
Yellow corn -----10 lbs.	Yellow corn meal -----2	lbs.
Other grains* ----- 5 lbs.	Bran -----2	lbs.
*(See discussions on pages 8 and 9.)	Shorts -----2	lbs.
	Meat Scrap -----1½	lbs.
Oyster shell or soft limestone rock finely crushed and clean water should be available at all times.		

Slight changes may be made in the suggested mash formula with satisfactory results, although there is danger in radical changes. Changes that make the ration more economical without

decreasing its efficiency are highly desirable. Frequently shorts contain so much bran that they are practically a mixture of bran and shorts, and in this case 400 pounds of shorts might be used instead of the 200 pounds of each suggested. Ground oats, if low in fibre, might also be substituted for the bran and shorts. Ground wheat or a mixture of wheat and corn ground together makes an excellent base for a mash, and where home grinding is done this may be cheaper than the other mash materials. The substitution of 5 per cent alfalfa leaf meal for an equal amount of bran and the use of 5 per cent dried milk for an equal amount of meat scrap are desirable changes in the ration used to produce eggs for hatching. These changes are suggested in the following mash formulas:

Six Formulas for Laying Mash

**

	No. 1	No. 2	No. 3	No. 4.	No. 5	No. 6
Yellow corn meal (lbs.)	200	200	200	200	200	200
Bran (lbs.)	200	---	165	165	165	50
Alfalfa leaf meal (lbs.)	---	---	35	35	35	---
Shorts (lbs.)	200	400*	200	195	200	---
Ground wheat (lbs.)	---	---	---	---	---	350
Meat scrap (lbs.)	150	150	150	75	115	150
Dried milk (lbs.)	---	---	---	---	35	---
Soybean oil meal	---	---	---	80	---	---
Salt (lbs.)	7	7	7	7	7	7
Fish oil (lbs.)***	7	7	7	7	7	7

*If high in bran content.

**Mash suggested for breeder ration.

***Fish oil as recommended in the above rations, applies to the period of winter months from October or November to April first. It is essential in breeder rations and normally desirable for flocks producing market eggs.

The poultryman who is able to supply liquid skimmilk may do so to advantage, knowing that 3 to 4 gallons of milk daily for 100 hens will satisfy the protein requirements as a substitute for the 1½ pounds of meat scrap. On the other hand, if only 2 gallons are available, it should be fed with a mash containing only 10 per cent meat scrap instead of the 20 per cent used in the standard formula.

FEEDING THE GRAINS

Feeding should be reduced to a routine to be adhered to with strict regularity. Ordinarily a light feed of grain, about 5 pounds for 100 hens, is fed early in the morning, especially in the winter. During the warm months little or no grain is fed in the morning.

At night the hens should be given all the grain they will eat. The amount of grain eaten at night is also less in summer than during the winter.

There is a growing tendency among poultrymen to feed the grain in hoppers. Leghorns apparently do just as well on this method of feeding, but the general purpose breeds should have only limited access to grain in the morning as they are likely to over-eat on grain thereby reducing their consumption of the laying mash. The arguments in favor of hopper feeding grain are that it is more sanitary and the birds can eat all they want just before going to roost. Many poultrymen feed the grain in troughs for the same reason.

FEEDING THE MASH

Mash should be fed dry in hoppers where the birds have access to it all the time. Liberal feeding space must be provided—not less than one linear foot of mash hopper for each five to seven hens. For 100 hens a mash hopper which feeds from both sides should be 8 feet long. The amount of mash actually consumed is dependent on the amount of grain fed, its palatability, and the appetites of the birds. The more mash the hens eat the more eggs they will lay. The daily allowance for 100 hens is 7½ pounds.*

RATION SHOULD BE LOW IN FIBRE

The use of bulky feeds such as grains with hulls should be limited to not more than one-third of the total whole grain feed. Poultry are unable to utilize fibre. For the same reason the use of bulky material such as bran or alfalfa or the two combined should not constitute more than one-fourth of the mash. A ration containing from 5 to 7 per cent crude fibre is most desirable.

SUCCULENCE

Where grains other than yellow corn constitute the greater part of the ration, green leafy material is necessary as a source of vitamin A. The use of green feed is also desirable in producing eggs for hatching. When yellow corn is fed and bran is used in the poultry mash, however, there is little to be gained by the use of green feed.

MAINTAINING BODY WEIGHT

Pullets frequently lose weight after two or three months of heavy egg production and if prompt attention is not given they are likely to cease laying and molt. If taken in time this condition

*For feeding equipment see Mo. Agricultural Extension Circular No. 419.

can usually be corrected by giving a supplementary feed of moistened crumbly fattening mash each day at noon until the pullets have regained the weight lost because of rapid laying. For 100 pullets 3 to 5 pounds daily of the following mash should produce the desired results: Corn meal 6 lbs., shorts 3 lbs., and dried milk 1 lb. If skimmilk is used to moisten the mixture the dried milk may be omitted.

ARTIFICIAL LIGHTING

Artificial lighting of the poultry house in winter is used by some poultrymen to stimulate egg production during the season when higher egg prices prevail. This enables the hen not necessarily to eat more feed but to distribute her feed consumption over a longer portion of the day. A practical plan is to place grain in the troughs and light the house for one-half hour, allowing the hens to fill up from 8:00 to 8:30 each evening.

A new method of lighting that has met with favor is the use of all-night lights. This consists of burning a light, not especially bright, throughout the night, having grain, mash and water available at all times. Remarkable results in preventing fall molt in Leghorns or in enabling them to recover from a fall molt and in maintaining high winter egg production with the general purpose breeds have been attributed to the use of all-night lights.

It is not considered wise to use lights with late molting hens until after January 1, but with early molting hens and early hatched pullets lighting may be practical from October 1 to March 1.

METHODS TO BE AVOIDED

From a sanitation standpoint hens should never be fed on bare yards. To depend too much on the scavenger activities of the hens, also, invariably results in reduced egg production.

GRAINS USED IN LAYING RATIONS

Corn.—In Missouri yellow corn should make up about two-thirds of the grain feed. Yellow corn is an excellent source of vitamin A, and without yellow corn the ration should contain clover or alfalfa hay. Green corn, moldy or musty feeds should never be fed.

Wheat.—Though one of the most popular poultry feeds, wheat is usually more expensive than corn and has little if any additional feeding value. If wheat costs more per pound than corn its use

is questionable. Where wheat is used, better results will be obtained if it is supplemented with corn rather than being used as the only grain feed.

Oats.—Light oats are undesirable as a poultry feed, yet heavy oats may safely constitute one-third of the grain used. The use of oats should depend on their availability, quality and price.

Barley.—Where readily available barley may be considered a substitute for oats.

Other Grains.—Cane, milo, and kafir may be used to the extent of one-third to one-half the total grain feed, so long as the remainder is yellow corn. Rye is unpalatable to poultry.

MASH INGREDIENTS

Wheat Products.—Bran in limited quantities is a valuable ingredient in poultry mashes, since it insures adequate bulk, is high in ash, and contains other valuable nutrients. Middlings, frequently called shorts or shipstuff, is a less bulky feed than bran, and its nutrients are more digestible. It should be mixed with bran, since a mash too high in middlings is pasty. It may constitute from one-fourth to one-third of the total mash. It should not be confused with reground bran. Ground wheat, if available at a cost comparing favorably with that of mill feeds, may be used as a substitute for bran and shorts. To avoid pastiness it should be supplemented with enough bran to make a mixture of about the same mechanical nature as the standard mixture of bran and shorts.

Corn Meal.—Corn meal is a very valuable mash ingredient, usually comprising one-fifth to one-fourth of the total mash, but must be handled with discretion. Unless mixed with bulky material it may heat and become moldy.

Ground Oats.—Heavy oats, ground, are an excellent poultry feed and may be used as a substitute for middlings. Light oats are of little value and may cause digestive disorders.

Alfalfa Meal.—Alfalfa meal is frequently used in poultry mashes. Pea green alfalfa leaf meal is preferable to ground alfalfa hay, since the latter runs much higher in fibre. Used in mashes, alfalfa leaf meal may be substituted for bran up to 5 per cent of the total mash. Well cured alfalfa and clover hay, being excellent sources of vitamins A, and G are frequently kept in racks before the hens during the winter.

Salt.—Salt should constitute 1 per cent of the total mash.

Meat Scrap.—Meat scrap is a by-product from the packing house. It contains 50 to 60 per cent protein. It is best fed mixed in the mash, usually using 1 pound meat scrap to each 4 pounds of other ingredients.

Tankage.—Tankage is similar to meat scrap, but not quite so good as a poultry feed. Hens fed tankage instead of meat scrap at Missouri Station produced 10 per cent fewer eggs.

Milk Products.—The use of milk as the animal protein in poultry rations increases both the number and size of eggs laid and improves their hatchability. Liquid skimmilk and buttermilk have about the same feeding value and may be used as substitutes for meat scrap or tankage, the daily allowance being $3\frac{1}{2}$ to 4 gallons for 100 hens. Dried buttermilk and skimmilk are lower in protein than meat scraps and are more expensive. One pound of the dried milk is equivalent to 10 of the liquid or 3 of the condensed.

Protein Concentrates of Vegetable Origin.—At the Missouri Station soybean oil meal has been successfully used as a substitute for meat scrap when 13 pounds of bone meal was added to each 100 pounds of soybean oil meal used and the mash contained one per cent salt. Since meat scrap contains from 10-15 per cent more protein than does soybean oil meal one should add 1.15 pounds of soybean oil meal for each pound of meat scrap removed. If soybean oil meal and meat scrap are used in equal amounts as the protein concentrate it is not necessary to add additional mineral in the form of bonemeal.

UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE AND THE UNITED STATES
DEPARTMENT OF AGRICULTURE COOPERATING

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