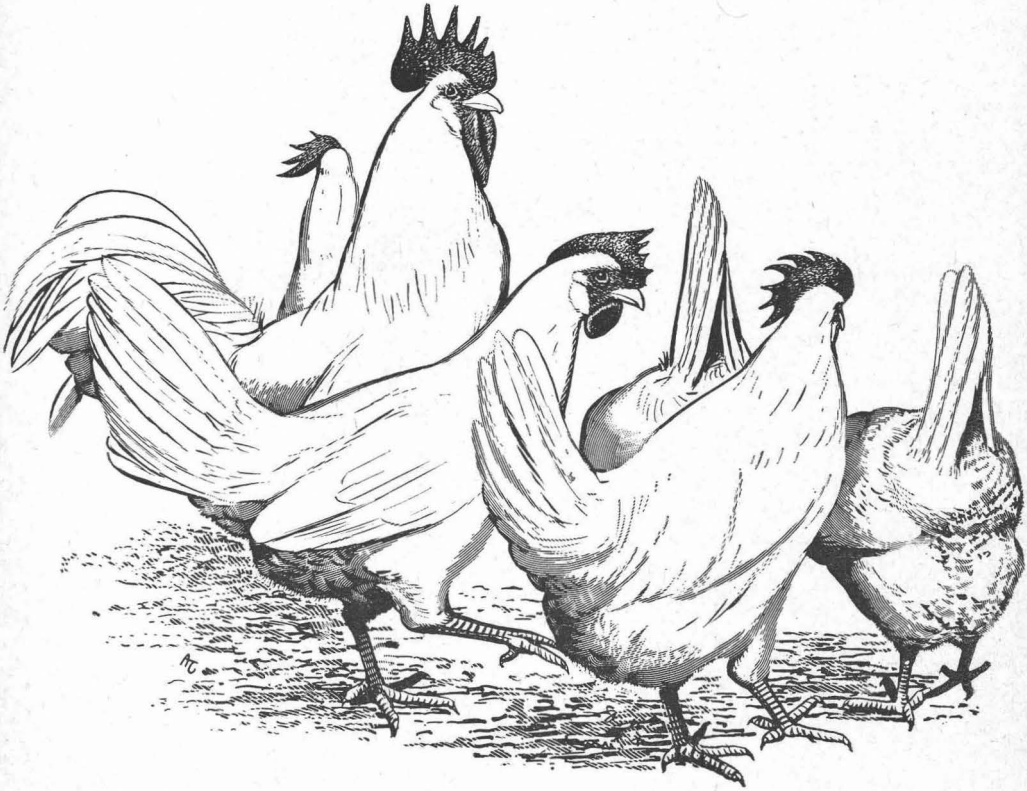
Feeds for Laying and Breeding Hens



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Feeds for Laying

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Contents

The production of eggs for market is an enterprise in which only a relatively small profit per dozen is made by efficient operators. The profit margin does not provide sufficient leeway for the individual poultryman to experiment with feeds or methods of feeding. Until experience warrants, the producer will have better success by accepting proved feed combinations and adhering closely to some definite, approved feeding method.

Feed represents the largest cost item in the business of producing eggs. Mass production practices, increased egg production per hen, year-round confinement of laying stock in houses and cages, and many other deviations from natural methods have increased the complexity of the problem. Recent findings in poultry nutrition research have not only reduced feed costs per dozen eggs through more efficient rations, but have made it possible to use less expensive feedstuffs in these rations. Continued research should lead to still greater efficiency.

nd Breeding Hens

Feed Nutrients

Content of feeds

Both feeds and eggs contain the same nutrients—proteins, carbohydrates, fats, minerals, vitamins, and water. The proportion of each nutrient varies in different feeds. The poultryman must aim to furnish the correct supply of each for egg manufacture. Only a portion of each nutrient in poultry feeds can be assimilated by the birds, hence the variation between actual feeding value and chemical analyses. For example, one feed may contain a large amount of fiber that will affect the digestibility or availability of other nutrients present. Some proteins are more complete for the required amino acids than others; consequently their feeding value is greater, though chemical analysis would show them to be the same.

Nutrients

• *Carbohydrates and fats.* Most grain feeds supply carbohydrate in large amounts but do not contain protein, minerals, or vitamins in amounts or quality to maintain egg production. Carbohydrate is composed of nitrogen free extract and crude fiber. While nitrogen free extract serves as a major source of energy, only part of the crude fiber can be used by the hen. Grains vary greatly in fiber content, and the use of high-fiber feeds is dependent on energy needs.

Fat also serves as a source of energy and is found not only in grains but also in numerous other feedstuffs such as meat meal or fish meal. It is also presently available as a byproduct of the meat rendering industry. Fat is not yet extensively used in laying rations.

Carbohydrates and fats provide the energy that the hen requires. This requirement is expressed as metabolizable energy. It is that energy utilized for metabolism, maintenance, work, egg production, and growth or fat deposition.

Feed intake has been observed to be related to the energy content of the diet. As the energy content increases, feed consumed decreases provided rations are adequately balanced from the standpoint of other nutrients.

• *Proteins.* Protein is a highly important nutrient. There are many different proteins. In poultry feeding, the source and quality of any protein used must be considered more important than its quantity.

Proteins are broken down into amino acids in the process of digestion. Amino acids are classified a "essential" or "nonessential." The "essential" amino acids are those that cannot be synthesized in sufficient quantity to meet the bird's nutritive requirement and must, therefore, be supplied in the diet. Since most protein sources will not supply all essential amino acid, it is common practice to use combinations of protein-containing materials or in certain instances actual amino acids if commercially available. An example would be methionine and possibly lysine.

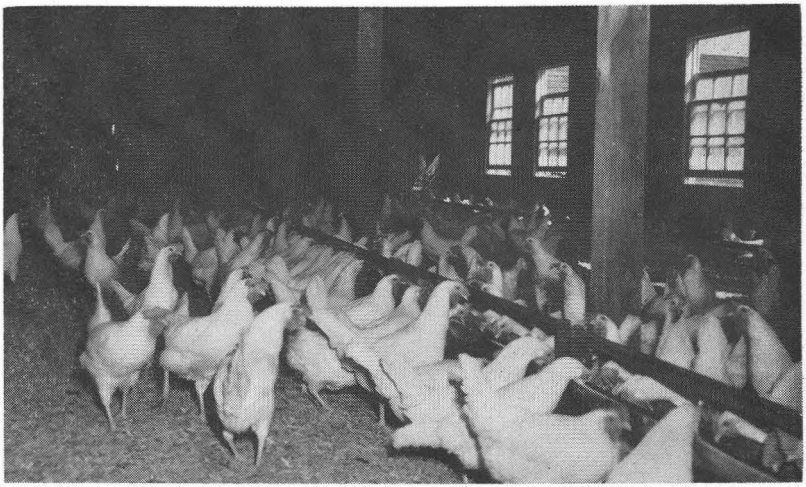
The poultry industry at one time depended on liberal feeding of milk products, meat meal, and fish meal as major sources of protein concentrates and vitamins. Currently, however, the industry depends heavily on such vegetable protein concentrates as soybean, cottonseed, alfalfa, or corn gluten meals; various grain byproducts; brewery and distillers' byproducts; and to a lesser extent peanut, sesame, sunflower, and pea meals. It has been shown that vegetable proteins must be supplemented with certain animal protein supplements and vitamins for optimum hatchability and viability of progeny. Furthermore, to adequately balance rations from the standpoint of their amino acid content certain amounts of animal protein concentrates are often required.

• *Minerals.* Minerals constitute one of the six classes of nutrients. Unless care is taken that there is a sufficient supply of minerals available, both egg production and hatchability may decrease. Feeding minerals is much more important under present intensive poultry-growing conditions than it was under small-flock and free-range conditions.

Grains, their byproducts, and other vegetable feed stuffs are low in minerals and must be supplemented with ingredients of higher mineral content. They do not supply calcium, phosphorus, sodium, chlorine, and manganese in adequate amounts. A number of other minerals are of vital importance, but are supplied in sufficient amounts under ordinary conditions.

Oystershell or limestone grit kept before layers at all times supplies the needed calcium carbonate for eggshells. Bone meal or defluorinated rock phosphate is fed to supply both calcium and phosphorus. Manganese is required for shell strength and normal hatchability. It is available in several commercial grades of manganese sulfate. Iodized salt supplies sodium, chlorine, and iodine. Care should be taken that all added minerals are evenly distributed throughout the mash.

• *Vitamins.* Vitamins are nutrients required in minute amounts for normal health, growth, and reproduction. Some are stored in the body in limited amounts. Several have an important bearing in feeding for egg production and breeding purposes. These are vitamins A,



A poultry ration can be fed all-mash, pellet, or crumbles in an automatic feeder. Feeders are designed to keep feed before the birds at all times.

B_{12}, and D, as well as riboflavin and pantothenic acid. Others either are present in sufficient quantity in the usual feeds or do not affect poultry.

Vitamin A is supplied as carotene in green feed, alfalfa meal, and yellow corn. Fish oils supply liberal amounts of vitamin A. Commercially prepared sources of vitamin A are also available; for example, vitamin A and D feeding oils, and dry stabilized vitamin A. Vitamin A is necessary for egg production, hatchability in adults, and viability and growth of chicks. A shortage decreases resistance to diseases, particularly of the respiratory tract and eyes.

Vitamin D is present in certain fish oils and commercially prepared products, such as activated animal sterols. The vitamin strength of oils varies, but vitamin D does not deteriorate in mixed feeds as rapidly as vitamin A. The need for vitamin D is greater in cloudy and rainy weather, or when birds are closely confined in houses not admitting direct sunlight. Vitamin D is necessary for the utilization of calcium and phosphorus. A deficiency results in decreased egg production and shell thickness and faulty bone formation or rickets.

Riboflavin is found in liver meal, dried brewers' yeast, milk byproducts, alfalfa meal, fish meal, and meat meal. The synthetic product is relatively inexpensive and generally available. This vitamin not only improves egg production, but is particularly desirable for the production of eggs to be saved for hatching purposes.

Pantothenic acid is required for both egg production and normal hatchability as well as growth, viability, and the prevention of dermatitis in chicks. While most rations as formulated are able to supply the requirement for egg production with little difficulty, the requirement for normal hatchability must also be considered. Feedstuffs containing this vitamin are: liver meal, dried brewers' yeast, dried whey, and alfalfa meal. Synthetic vitamin concentrates are also available.

Vitamin B_{12}, the newest member of the B-complex series, has been shown to be necessary for normal hatchability as well as growth and viability of progeny. It occurs chiefly in animal protein supplements such as fish meal, condensed fish solubles, liver meal, meat meal, and dried skim milk. Plant protein supplements, on the other hand, are relatively low in vitamin B_{12} content. Although a certain amount of synthesis of the vitamin may occur when birds are housed on built-up litter, this practice does not insure a constant source of vitamin B_{12}. Addition of 5% fish meal or 3% condensed fish solubles to an all-mash feed will meet the breeder hen's nutritive requirement for the vitamin, as will several commercially prepared vitamin B_{12} supplements fed as recommended.

An unidentified factor necessary for normal hatchability involving hens fed an all-vegetable type ration adequately supplemented with vitamin B_{12} and other known nutrients has been reported. Although differences in hatchability are small, it is believed desirable to include carriers of this unknown nutrient in the ration of the breeder hen. While only limited data exist at present as to the sources of this factor, it is felt that certain animal protein supplements such as fish meal, fish solubles, or meat meal may provide an adequate level of this factor.

Use of feeds

The first use of feed by the hen is for body maintenance. Approximately 65 to 75% of her normal feed intake is used for this purpose. A limited supply of feed might be sufficient only to maintain body needs. Eggs are manufactured by the hen from the liberal supply of essential nutrients consumed in excess of body requirements. A laying hen will deplete her body of reserve nutrients only to a limited extent, then cease production. Hence it is necessary to keep before her a reasonably constant supply of the essential nutrients so that she will not have to draw on this reserve.

Variety and palatability

A combination of several feeds permits the deficiencies of one to be made up from the nutrients in others. Palatability of feeds is important. Little is gained if, through lack of palatability, the feeds supplied are not consumed in sufficient amounts for heavy production.

Nutritional requirements

Considerable data on nutritive requirements for the production of eggs for commercial and hatching purposes have been obtained. Table 1 lists recommended levels of protein, vitamins, and minerals to be considered in the formulation of practical layer and breeder rations. Many nutrients are not included since they will always be supplied in adequate amounts in commonly used feed ingredients. In some cases the requirements for these nutrients have not been established. In rations for layers, allowances for vitamins A and D are considered the same as for breeders.

Table 1. Recommended nutrient allowances for laying and breeding hens[1]

Nutrients	Amount
Protein, percent	15
Crude fiber, percent	6[2]
Vitamins	
Vitamin A activity, U.S.P. units/lb.	3,200
Vitamin D, I.C. units/lb.	340
Riboflavin, mg./lb.	2.1 (1.2)[3]
Pantothenic acid, mg./lb.	5.0 (2.5)
Vitamin B_{12}, mcg./lb.	2.4 (?)[4]
Minerals	
Calcium, percent	2.25[5]
Phosphorus, percent	0.6
Salt, iodized, percent	0.4[6]
Manganese, mg./lb.	15 (?)
Iodine, mg./lb.	0.5 (0.2)

[1] Adapted from *Nutrient Requirements for Poultry,* Rev. 1960, National Research Council Publication 827.

[2] As a general rule crude fiber should not exceed this value.

[3] Figures in parentheses represent a decreased allowance when hatching eggs are not desired.

[4] Where "?"'s are shown, no requirement has been established. Experience indicates that commercial rations generally contain an adequate level of these nutrients.

[5] This level is included if no additional calcium supplement is fed (see text p. 15).

[6] Represents added salt.

Effect of feeds on internal egg quality

Excessive feeding of highly pigmented feeds such as alfalfa meal, kale, rape, rye pasture, and certain weeds like shepherd's purse, mustard, and pennycress will give an undesirable deep color to egg yolk. Yellow corn will also darken yolks but its use is generally accepted. A large percentage of cottonseed meal in the ration will result in yolk color for storage eggs varying from salmon and dark green to nearly black, and the whites will vary from normal color to pink. Excessive feeding of onions, fish meal, and fish oils may give the eggs an undesirable flavor.

Feeds for Egg Production

Ration formulas

In formulating rations for egg production or breeding purposes no one formula is best; neither is any particular feed ingredient indispensible. The type of ingredients to use depends on several factors—foremost are nutritive content, palatability, availability, digestibility, and price. The end result requires that *rations be designed for the purpose intended.* For example, with breeder rations, as noted in Table 1, higher levels of certain nutrients are recommended. These higher recommendations insure a sufficient "carry-over" of certain nutrients from the hen to the egg for normal hatchability, and from the egg to the chick for normal viability and optimum growth. In the formulation of any ration, not only should the allowances cited in Table 1 be followed, but also information on the nutritive content of feedstuffs should be available. A summary entitled *Joint United States-Canadian Tables of Feed Composition,* published by the National Research Council, Washington, D. C., 1959, as publication 659 provides extensive information on composition of feedstuffs.

A well-balanced ration is required for high production and eggs of good quality.

Since ration formulas are subject to periodic revision, they are not included in this bulletin but may be obtained on request in leaflet form from the Department of Poultry Science.

Mash rations

All manufactured feeds unless further processed are in mash or ground form. Whether or not they are to be fed as the only source of nutrients or further supplemented with grains is dependent on the feeding system selected (see page 11).

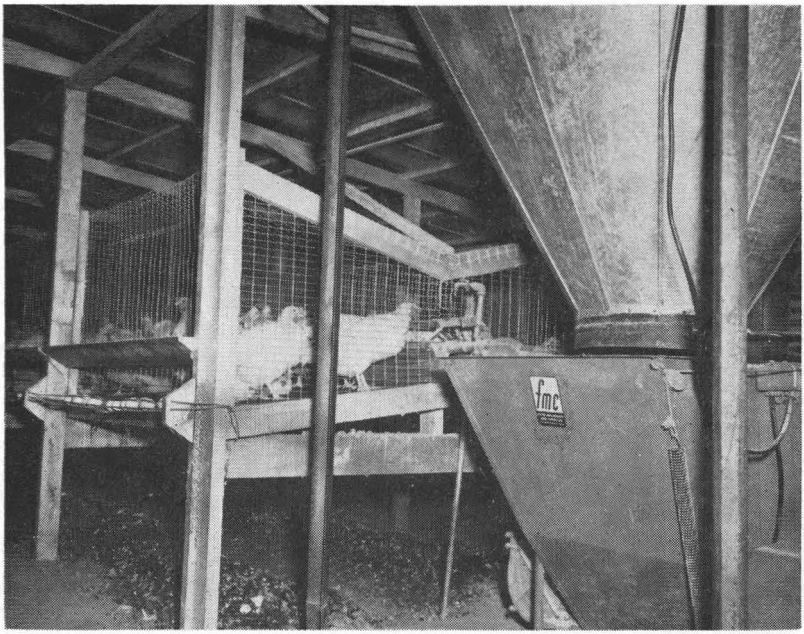
Pellets

Many manufactured feeds are now available in pellet or crumbles form. Pellets may also be used in a supplemental feeding program (see page 13). Advantages of pellets or crumbles over mash feeding are:

- Reduces feed wastage.
- Eliminates selection of ingredients within a mash.
- Permits more efficient use of high fiber feeds.

Disadvantages of pellets or crumbles are:

- Increases cost.
- Increases moisture content of droppings.
- Increases feed intake without increasing production.



Labor-saving automatic feeders are frequently used for layers in community cages. Bulk feed bins may empty directly into the automatic feeder.

Scratch grains

Oregon produces a surplus of high-quality wheat, oats, and barley. It is wise to make generous use of these home-grown feeds where economically feasible. Oregon's corn production has not equalled its use though local production is increasing. A heavy tonnage of corn is still shipped into the state despite high transportation costs.

Yellow corn is palatable and serves as an excellent source of energy, also of vitamin A. Kafir, milo, buckwheat, and other less common grains are not generally available in Oregon in sufficient tonnage to make them economical feeds, but are satisfactory substitutes when available at reasonable prices.

Barley is available in considerable quantity in Oregon. It contains less energy than corn or wheat, but more than oats. It may be substituted for corn, oats, or wheat, but normally should not constitute more than 75% of the scratch feed. Barley is less palatable than corn, wheat, or oats, and poultrymen should gradually teach the birds to eat it rather than suddenly incorporate it into the scratch mixture. A desirable practice would be to have some barley in the scratch mixture fed to developing pullets. Poultrymen generally prefer Hannchen barley for feeding whole because the objectionable awns are knocked off in threshing. Some of the more heavily bearded varieties may be rolled before feeding.

Oats are classed as a low energy feedstuff but may be used when available. Heavy, thin-hulled oats have a better feed value than lightweight oats. They are not quite as palatable as wheat or corn, probably because of their higher fiber content. Oats normally should not be used in excess of 50% of the scratch grain by weight.

Wheat is also a good energy source. Its use in feeds has been somewhat restricted in recent years, but this trend might be reversed

Table 2. Suggested scratch mixtures for laying and breeding hens

Ingredient	High energy	Medium energy	Low energy
	Pounds	*Pounds*	*Pounds*
Barley	500	1,000	1,000
Corn[1]	1,000	500	.....
Oats	.....	500	1,000
Wheat[1]	500	.....	.....
Total	2,000	2,000	2,000

[1] May be substituted for each other or replaced with milo.

in the future. When available, it serves as an excellent grain as it is high in carbohydrate and low in fiber. It may completely replace yellow corn if the vitamin A content of the corn is supplied from some other source.

A scratch grain mixture is determined more by availability and prices of ingredients than by any set formula. Although there are experimental data to show that layers will perform satisfactorily when they are fed a single grain as a scratch feed, not less than two different kinds of grains should be used in the scratch mixture. Three suggested scratch mixtures for laying and breeding hens are listed in Table 2. Selection or variation of any one of these mixtures may depend on local conditions.

Water

Because both the fowl's body and the egg are high in water content, a good supply of water is necessary. An egg contains approximately 67% water. One hundred laying hens will require 5 to 6 gallons of water per day. Some factors that influence water consumption are: rate of laying, body size, temperature, and mineral or fiber content of feeds.

Feeding Systems and Practices

All-mash feeding

All-mash or complete feeds are fed to birds on a free choice basis, and should always be available in feeders. *Scratch grains should not be fed to layers receiving an all-mash feed.* Trough feeders generally used hold only a limited supply, necessitating daily fillings; thus insuring a fresh supply of mash and the opportunity to check on its consumption. The use of mechanical and drum-type feeders with all-mash feeding programs is increasing. With this innovation the feed supply may be available to the bird for several days or longer. In any event, close observation should be kept of feed consumption and the general well-being of the birds.

Economical use of mash is influenced by the amount of trough space provided. Insufficient trough space promotes crowding and reduces feed consumption. A minimum of 25 lineal feet of trough or hopper space should be available for each 100 hens. A regular trough 8 feet long with feeding space on both sides provides 16 lineal feet of hopper space.

The tentative daily feed requirement per 100 layers based on body size and rate of production is given in Table 3. Thus it can be seen that 100 birds, averaging 4 pounds in weight and laying 60 eggs daily, will consume approximately 24 pounds of feed per day. These

Table 3. Approximate daily feed requirements for 100 layers, as influenced by body weight and rate of lay[1]

Body weight	Daily feed required per 100 birds for various production rates, by percent of lay				
	0%	20%	40%	60%	80%
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
3 pounds	12.8	15.6	18.5	21.3	24.2
4 pounds	15.5	18.3	21.2	24.0	26.9
5 pounds	17.9	20.7	23.6	26.4	29.3
6 pounds	20.2	23.0	25.9	28.7	31.6
7 pounds	22.3	25.1	28.0	30.8	33.7

[1] Based on data by T. C. Byerly, 1941.

amounts may also be influenced by the energy content of the feeds. High energy feeds will decrease the amounts of feed required, whereas low energy feeds will bring about increases in feed consumption.

Mash-scratch feeding

When supplies of locally grown grains are economically available, a mash-scratch feeding program may be employed. The mash that is fed with scratch grains must contain more protein, vitamins, and minerals than when feeding on an all-mash system since these nutrients are usually concentrated to a greater extent in the mash and not in the scratch grains.

Table 4. Recommended protein levels for mashes with different mash-scratch ratios[1]

Ratio of mash to scratch used	Percent protein required in mash
1:0[2]	15
1:1	20
1:2	25
1:3	30
1:4	35
1:5	40

[1] Assuming a protein requirement of 15% and 10% as the average protein content of the scratch grain mixture used.

[2] This ratio is the all-mash system of feeding.

For the conventional mash-scratch system where the scratch grain comprises 50% of the total feed intake, the protein content of the mash used should be increased from 15% to 20%. When it is desirable to feed greater amounts of scratch grains, protein concentrate mashes containing up to 40% protein may be used. In Table 4 the recommended protein contents of mashes fed with different mash-scratch ratios are given.

Use of scratch grains

Scratch grains can be fed in two ways—either by feeding all of it in the late afternoon, or by feeding approximately a third of it in the morning and the remainder in the afternoon. Because of the labor involved, most poultrymen prefer to feed scratch grains only in the afternoon. Scratch grains are fed in hoppers or scattered on top of the litter. Feeding some of the scratch in the litter may encourage the birds to stir the litter.

Scratch grain feeding should be based on recommendations accompanying the particular mash used. (See Table 4.) Overfeeding grain will result in decreased consumption of mash and an inevitable drop in egg production. Underfeeding will increase costs resulting from poor utilization of protein and other nutrients. Daily consumption of 100 White Leghorn hens will range from 10 to 15 pounds of grain dependent upon the rate of lay and body sizes. (See Table 3.)

It is sometimes necessary and desirable to control the amount of energy available to layers. This can be most effectively accomplished not by varying the ratio of mash to scratch as is often practiced, but by increasing or decreasing the concentration of high or low energy grains in the scratch mixture. For example, during the winter months when energy needs are greater, larger concentrations of corn, wheat, or milo may be employed in the scratch mixture. (See Table 2.) On the other hand during the summer when feed intake sometimes decreases due to higher environmental temperatures, lowering the energy content by the use of oats and barley will tend to increase consumption.

Supplemental feeding

Occasionally it is necessary to vary the routine method of feeding. Supplementing with more appetizing feeds to increase the fowls' intake of food will meet such emergencies as sharp reductions in production, partial molts, sluggish appetites, attempts to hold up production through the molting season, and unfavorable temperature conditions. Some supplemental systems are:

- Intermittent use of high-level antibiotic feeding, 50 to 200 gm./ton of ration, is a recently developed practice to stimulate feed consumption. Such feeds are now available.

Pullets should be moved from the range into laying houses before they come into production.

- Mash moistened with water is an excellent supplemental feed. It should be given in an amount that the hens will consume eagerly in 20 minutes, usually about 2 pounds of mash per 100 birds. Moist mash may be fed in the middle of the day or after the evening grain feed.
- Two to four pounds of pellets fed daily to each 100 hens is an excellent supplemental feed.
- Liquid or condensed milk or concentrated milk products are sometimes fed to stimulate feed consumption.
- Green succulent feeds, not exceeding 2 to 4 pounds daily per 100 hens, may also be used when available, provided a problem does not arise from darker yolks.

A supplemental feed may be gradually discontinued when the desired results from its use have been obtained.

Oystershell and grit

Unless otherwise noted, most rations require free choice supplementation with oystershell or limestone grit. Because of the increased use of caged layers and mechanical feeders, however, some all-mash rations are now formulated to contain a sufficient quantity of calcium in the form of limestone flour. No added oystershell is then required.

It has recently been recognized that even though a ration may contain 2.25% calcium (see Table 1), this may not be an adequate amount under all conditions, especially for adequate shell thickness. The trend toward smaller body size and high energy type rations with the accompanying decrease in feed consumption have contributed to this. The fact that layers have been continually selected for increased egg production is also a factor. A method has been reported for estimating calcium needs for layers using the criteria of feed per dozen eggs and assuming that approximately 0.12 pounds of dietary calcium is required to produce a dozen 2-ounce eggs. In Table 5 the estimated calcium levels in rations for varying values of feed required per dozen eggs are given.

Table 5. Estimated levels of calcium in rations for varying amounts of feed required per dozen eggs[1]

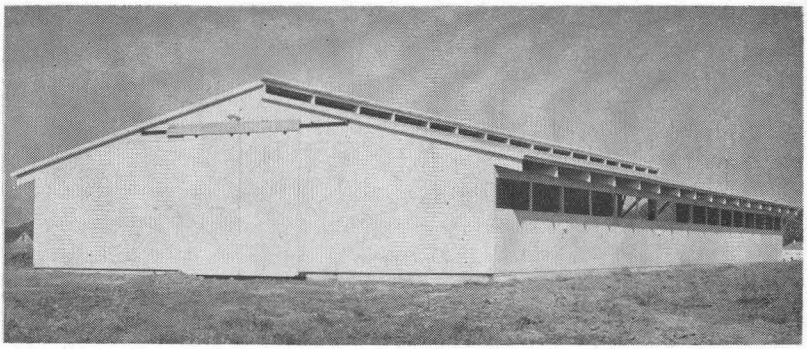
Feed per dozen eggs	Calcium in ration
Pounds	*Percent*
3.0	4.0
3.5	3.4
4.0	3.0
4.5	2.7
5.0	2.4
5.5	2.2
6.0	2.0

[1] Adapted from data of Combs and Helbacka, 1960.

Grit is generally fed in separate troughs. The use of grit with all-mash rations is optional but desirable with the mash-scratch feeding program. Many poultrymen prefer a hard, acid insoluble grit because it lasts longer and aids in breaking down feeds high in fiber. Others use soluble limestone grit because, like oystershell, it supplies calcium. Caution must be exercised in using limestone grit to avoid excess magnesium sometimes found in dolmitic limestone.

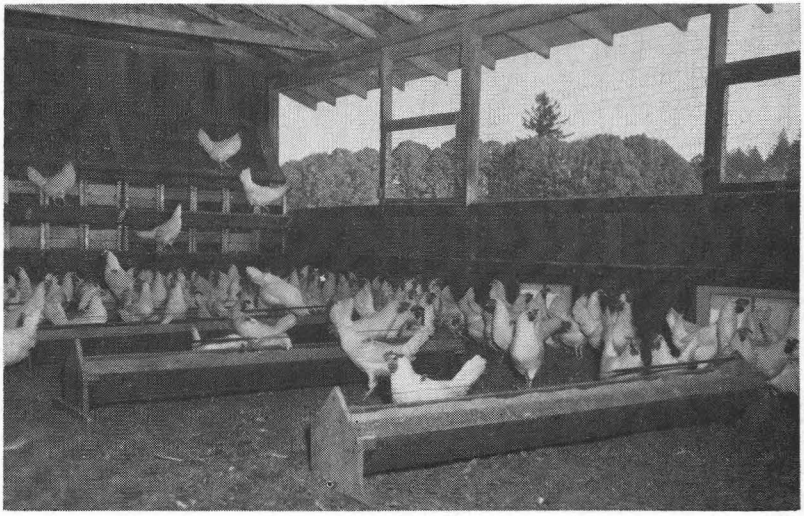
Feeding and Housing New Pullets

The time or age at which pullets are housed in permanent laying quarters may vary considerably depending upon the strain of chickens, individual preference of operators, weather, and pressure of other work. In general, pullets should be housed by the time they



Many pullets never see the open range. A single well-planned building may be used for brooding, raising pullets in confinement, housing breeders or layers for market eggs. This type of building could include bulk feed bins and an automatic feeder.

reach 10 to 15% egg production. Housing the pullets shortly before egg laying starts is desirable but may not always be consistent with maximum utilization of buildings. On the other hand, there is also interest in rearing pullets in the same pens or houses that are used for layers. This saves labor and reduces stress to the pullets due to moving them.



Pullets should be housed according to their physical and sexual maturity. They should be housed as the first birds begin to mature—4½ to 5 months of age with early-maturing strains.

Replacement pullets may be changed from the developer mash to the layer or breeder mash shortly before or shortly after they are housed. It is not a good practice to change the feed at the same time that the pullets are housed. Always make as few major changes at one time as is practical.

Range houses should be equipped with a few nests for those pullets that lay before being moved into permanent houses. Pullets that form the habit of laying on the floor or ground while on range become easy prey for cannibalistic and curious mates when they continue the habit in the more crowded laying house.

Range-reared pullets may be fed some green feed for a few weeks after they are housed. This practice makes the change from range to confinement less abrupt, and may aid in reducing feather picking and cannibalism.

Feed should be readily available to encourage feed intake for the first few days after housing. A few extra troughs of feed placed on the floor will help prevent any decline in feed consumption after housing. Likewise, if radical changes are made in watering equipment, additional open water containers will be helpful during the changeover.

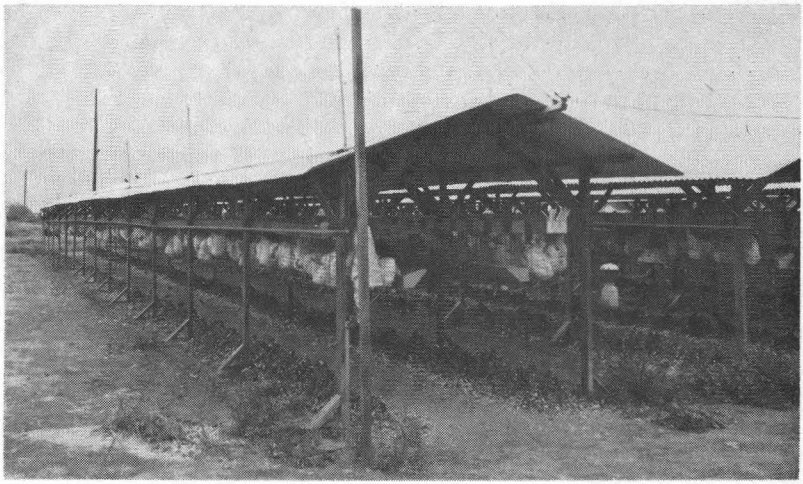
Feeding Breeding Hens

As previously noted, a more complete ration is required to meet the needs of hens producing hatching eggs than of those producing commercial eggs. Ordinary egg mash does not always meet needs of the breeding flock. Commercial egg production may be obtained on rations less costly than breeder mashes. The fact that a flock maintains high egg production on an egg mash is no guarantee that high hatchability or strong chicks will result.

Breeder hens require greater amounts of vitamins A, D, and B_{12}, riboflavin, and pantothenic acid than do laying hens fed for market egg production. Similarly, breeder hens require greater amounts of manganese and iodine. A definite reduction in hatchability occurs on a ration deficient in manganese. Whenever practical, a breeder ration should be fed 2 to 4 weeks prior to saving eggs for hatching.

Feeding Layers in Cages

While most commercial layer and breeder flocks are kept in conventional type poultry houses with litter on the floor, some poultrymen keep laying hens in individual cages of the inside or outside type. Others prefer to house their birds in community cages in groups of from 15 to 30 per cage. Birds in wire cages receive no additional



Open air cages for layers are used extensively in western Oregon. Layers should be protected from sun and strong winds. Lath fences, frames of muslin, or canvas are often used as windbreaks.

nutrients from poultry house litter, soil, or pasture. Therefore, the ration fed must be complete and balanced with respect to nutrients required, or results are certain to be unsatisfactory.

Over a number of years results at the Oregon Agricultural Experiment Station have shown that layers in cages of either the inside or outside type can be fed the same rations as those recommended for regular flocks on litter. It has also been found that layers in cages will lay just as well on an all-mash ration as on a mash and scratch grain ration.

In cage setups equipped with mechanical feeders, the use of an all-mash ration is desirable. In some cases, oystershell and hard grit are also included. It should be pointed out, however, that with certain types of mechanical feeders, mixing grit in the mash may result in damage to the equipment.

Where mash and grain are fed, the birds should be given one daily feeding of grain. The grain can be fed on top of the mash. The birds should have free access to insoluble grit, oystershell, and fresh water in addition to mash and grain feeds.

Cages are not generally recommended for breeding hens.

Other Management Practices

Artificial lights

Lights may be used for maintaining egg production during that portion of the year when there are less than 12 to 14 hours of daylight. In Oregon, lights are generally in use from September to April. Lights may be used in the morning, evening, or during either period to supply 13 to 14 hours of continuous light. A 60-watt bulb is usually adequate for each 200 square feet of floor space, and should preferably be placed over the feeders. A cone-shaped reflector may be employed. Suitable time clocks and light intensity controls are now available.

Care of broody hens

Abuse of broody hens may result in extended periods of nonproductivity. Broodiness may be curtailed by confining these hens to wire- or slat-floored cages that are readily accessible, and supplying them with ample feed and water. Restricting feed or water is not desirable. When observed early, broody hens may generally be returned to the flock after 3 or 4 days' confinement.