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FEEDING REPLACEMENT PULLETS AND LAYING HENS

T. W. Sullivan and Earl W. Gleaves[1/]

Profit from a laying flock depends on many things. A good market, good breeding, efficient and economical feeding and good management are of utmost importance. This circular deals with feeds and feeding of laying hens.

Feed expense amounts to about 60 percent of total egg production cost. Therefore, labor return and profit obtained from a laying flock is greatly affected by feed quality and cost.

Nutrients

Birds do not actually require a series of feed ingredients. They need a series of nutrients which are found in the various ingredients. These nutrients are energy (carbohydrates and fats), protein, minerals, vitamins and water. Water is not usually considered a feed nutrient, but its importance must always be emphasized.

Energy is required for building new tissue, for body maintanance, for locomotion and for heat production. Corn, milo and certain other grains are the main energy sources in poultry rations. Animal and vegetable fats are concentrated sources of energy, which may be used to increase the energy content of the ration.

The requirement for **protein** is actually a requirement for certain amino acids. Proteins are composed largely of about 22 different amino acids with ccertain ones being more important (essential) than others. Laying hens need amino acids for the building of new tissue, egg production and body maintenance. Fish meal, meat scraps and other animal by-products are good protein sources. Soybean meal is also a good protein source, with one not too serious drawback —it does not contain methionine, one of the essential amino acids. Protein or amino acid requirements of birds can be met best by including several sources in the ration. Certain synthetic amino acids, including DL-methionine and L-lysine are now available for use in poultry rations.

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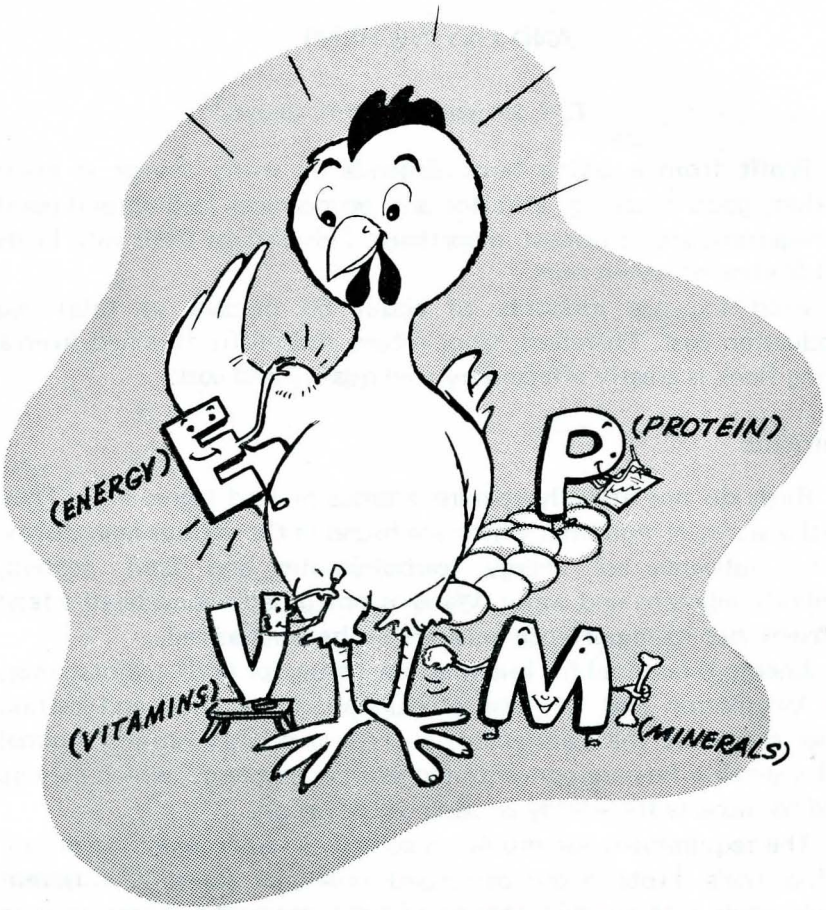
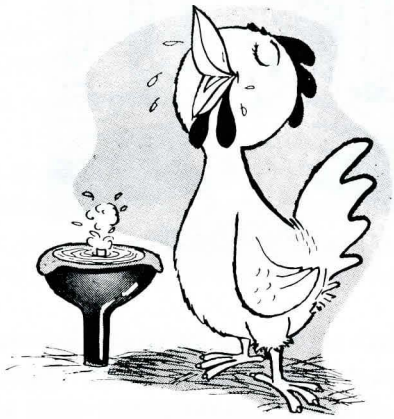


Minerals perform a variety of important functions in the bird's body. As major components of bones, skeleton and egg shell, certain minerals give rigidity to these structures. Minerals are needed for the formation of blood cells, blood clotting and numerous metabolic reactions. They are also very closely associated with the function of muscles. Of the minerals needed, calcium, phosphorus and salt (sodium chloride) are added in major amounts to feeds; iodine, iron, manganese and zinc are given in small or trace amounts.

Vitamins likewise perform a variety of important functions in the bird's body. Vitamin A is needed for vision and the health and well-being of the skin, linings of the digestive and respiratory tracts and other epithelial tissue. Vitamin D plays an important role in

bone formation and the absorption and transport of calcium. The B-vitamins are involved in energy metabolism and in the metabolism of many other nutrients and compounds.

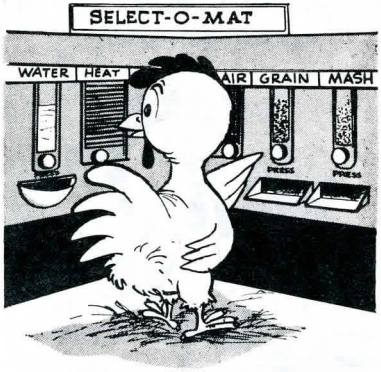


Water, which makes up 55 to 78 percent of the live weight of chickens, softens and hydrolyzes the food and transports nutrients, metabolic products and excreta. Water also acts as a lubricant and is essential for the regulation of body temperature. Chickens will ordinarily consume two to three pounds of water for each pound of solid food eaten. Egg production will stop sooner from a lack of water than from a lack of any other nutrient.

Feeding Systems

Feed may be given to laying hens in the following ways: (1) All-mash, (2) mash and controlled grain and (3) free-choice or cafeteria style. The choice of one of these feeding systems will depend mainly upon the flock size and the labor and equipment available.

The *all-mash system* is by far the most common. This is especially true for commercial size flocks. The proper nutritional balance is taken care of by man rather than letting the hen balance her own ration. In larger flocks this unsures against the possibility that thehen will not do a good job of balancing her own ration. All-mash feeding involves the use of a single mash which contains all components of the ration. Egg quality factors, such as shell thickness and yolk color, are more uniform and more easily controlled with



this system. An all-mash ration can be easily dispensed in hanging or automatic feeders. Les skill on the part of the feeder is required with the all-mash system. A calcium supplement such as crushed oyster shell or limestone granules can be made available free-choice, if desired. Also, a portion (1/2 or 2/3) of the calcium supplement in the ration may be larger particle size limestone or oyster shell.

Mash and controlled grain feeding can be, and is, used successfully in small to medium sized flocks of 50 to 2,000 hens. More care and attention must be given to the flock fed this way than the flock fed with all-mash. Mash and controlled grain feeding involves the use of a concentrate (20 to 23 percent protein), and limited amounts of whole grains and calcium supplement. The amount of grain fed should be calculated to make the total feed intake contain about 16 percent protein. Slight adjustments can be made seasonally to provide more energy in cold weather (more grain) and to provide less energy in hot weather (less grain). Grains may be placed in hoppers or scattered in the litter.

Free-choice or cafeteria style feeding is used successfully by some small flock owners. This system allows the birds to balance or regulate their own intake of grain and mash. All birds cannot do this satisfactorily. A highly concentrated mash (28 percent protein or more), whole grains and a calcium supplement are made available in separate hoppers.

If either of the two latter feeding systems are adopted, homegrown grains can be used for greater economy. The feed consumed should furnish the bird with all nutrients needed for egg production, regardless of the feeding system. Feeds or concentrates

of different composition, suited to the available grains, can usually be purchased locally. Feeding instructions are generally given or can be obtained from the dealer or a feed mill sales representative.

Recommended Feed Formulas and Mash-Grain Mixtures

Formulas for six complete all-mash laying rations are given in Tables 1 and 2. These rations should be economical to mix since most ingredients are readily available in Nebraska. By using different amounts of various feed ingredients, many other rations could be formulated. Give careful consideration to all factors involved before you decide to mix a complete ration starting with the individual ingredients.

When several thousand laying birds are kept, it may be economical to buy, store, grind and mix some or all of the ingredients of the ration. Local feed mills will usually "custom mix" complete rations for small or large flock owners. Complete feed formulas for starting chicks and growing pullets are presented in Table 3.

Many different commercial poultry concentrates are available. They range in protein content from 20 to 42 percent. Concentrates containing 26, 32 and 38 percent protein are most common; various proportions of each of these concentrates to be mixed with various grains for complete rations are listed in Table 4. The majority of flock owners, who feed an all-mash ration, should carefully consider using homegrown grains mixed with a concentrate to form a composite all-mash ration.

Problems Related to Feeding the Laying Flock

Level of Protein

Poultry nutrition authorities do not agree with regard to the best protein level for laying rations. Some recommend levels of 17 to 18 percent, while others feel 15 percent is adequate. Some of these differences have been resolved in recent years.

Good egg production has been obtained experimentally with purified rations containing only 12 to 14 percent of protein. The protein intake of the hen rather than the protein level of the rations is the important consideration. A number of factors influence feed

intake and consequently protein intake. Some major factors are: environmental temperature, energy level of the ration, disease condition of the flock, age of the hens, and level of egg production.

Laying hens in heavy egg production need 17-18 grams of protein intake per day. As they drop in egg production, only 13-14 grams of protein intake is needed per day. The protein intake of a flock can be regulated by keeping good records of feed intake and adjusting ration protein level as feed intake changes. High protein (17 to 18 percent) laying rations are needed in hot weather with young hens laying at a heavy rate. As hens grow older, or egg production drops, or winter weather comes on, the protein level in the ration may be reduced to 14 to 15 percent.

Some producers are successful, under normal conditions, with rations of 15-16 percent protein throughout the entire laying season. However, if this protein level is used, take care to use a good quality protein (plenty of essential amino acids). This is particularly true during the early stages of the laying cycle.

Egg Shell Quality

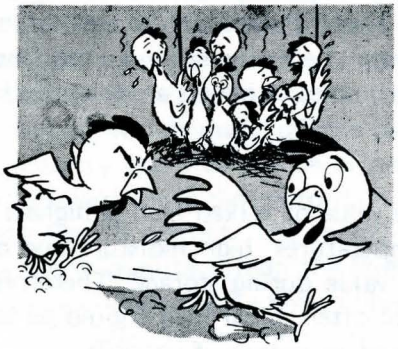
Several factors are involved in egg shell problems (soft shells, checks and cracks). As hens get older, shell strength and thickness decrease. After a long period of heavy egg production, the bird's hormonal systems are probably less active, and her stores of extra mineral (in the bones) become somewhat depleted. This depletion may be caused by inadequate levels of calcium and phosphorus in the laying ration during sustained heavy egg production.

High environmental temperature will cause hens to lay eggs with thinner shells compared to birds in more optimum temperatures (40 to 70^{o} F.).

Nutritional factors which affect egg shell quality are calcium, phosphorus, manganese and Vitamin D_3. Ascorbic acid (Vitamin C), added to laying rations at the rate of 1 to 2 ounces per ton, could increase egg shell thickness. Ascorbic acid does not produce this response consistently. Increasing the level of dietary calcium appears to be the most reliable means of combating the egg shell problems. Calcium levels as high as 3.75 and 4.00 percent of the ration have been fed experimentally with good results. Only 3.0 to 3.50 percent of calcium (in the ration) is normally recommended for hens in

heavy production; however, higher levels may be beneficial during heavy egg production in hot humid weather. The ration should also contain adequate levels of Vitamin D_3, phosphorus and manganese.

Recent studies indicate that feeding a portion of the calcium supplement in larger particle size as opposed to all finely ground material may have certain advantages, especially in hot weather. Greater egg production and shell strength have been obtained when 2/3 of the calcium supplement was of larger particle size (either oyster shell or granular limestone) and 1/3 was finely ground. Larger particles of calcium supplement apparently accumulate in the gizzard during the day, dissolve more slowly throughout the night and thereby maintain higher blood calcium levels. Also, large particles of calcium supplement seem to separate or segregate less than finely ground material when mixed into feed or mash.



Cannibalism

Cannibalism may develop as a result of overcrowding and various other environmental factors. Sometimes a deficiency of either protein or salt may induce feather picking and cannibalism. When this vice gets started in a flock, debeak all of the birds as soon as possible. The addition of extra protein or salt to the ration will help prevent cannibalism, but will seldom if ever stop it.

Grit

Grit aids the bird's gizzard in the grinding of coarse feed and particles of litter and feathers that may be ingested. Therefore, grit is more beneficial when whole grains are fed. When finely ground feed

in the form of an all-mash ration is fed, grit may have very little or no effect on egg production or feed utilization. Grit may be hard or soft and it may or may not contain calcium. Oyster shells and limestone granules are soft or soluble grits which provide calcium, but do not last long for grinding. Granite particles, river gravel and pebbles are hard, insoluble, long-lasting grits which do not supply calcium, but are best for grinding. Grit may be supplied free-choice to laying birds in hoppers separate from the feed.

Pellets and Crumbles

Pelleting increases the density of mixed feeds, but adds to the cost. Crumbles are pellets that are broken down into smaller sizes. These both have certain advantages over mash. Coarser particles of the mash might be picked out, and very fine powdery ingredients that might sift out are held in proper balance throughout the entire mix with pelleted feeds. Pellets are somewhat more palatable to poultry. There may be, however, a tendency toward more cannibalism when crumbles or pellets are the only feeds available.

Storage of Feed

The nutritive value of mixed feed is highest when it is freshly prepared. High temperatures, high moisture and other local factors may decrease feed value during storage. Therefore, feed should be mixed and delivered often. Most feed should be used within 3 or 4 weeks after it is mixed, or sooner, if possible.

Antibiotics and Related Additives

The use of low-level (4 to 50 grams/ton) antibiotic supplements which are approved by FDA, and related additives in rations for young growing birds is unquestionably a good practice. Increased growth and improved feed efficiency are consistently obtained in birds fed these supplements.

Antibiotic supplementation of laying rations may help prevent production slumps due to occasional subclinical infections and disease. Also, the intermittent (50-200 grams/ton) may be of value in maintaining health and production of the flock. The continuous feeding of antibiotic supplements in layer rations is usually not economical.

The Feed Tag or Label

The label attached to most commercial feed gives the guaranteed minimum content of crude protein, crude fat and nitrogen-free extract, and the guaranteed maximum content of crude fiber. Although this information is of general nature, it may be very useful. Crude protein values may be used in the mixing of an all-mash rations or to adjust the bird's protein intake when whole grains are fed.

Since the crude protein content of the feed is calculated from the total nitrogen content which is determined chemically, the quality of the protein (amino acid content) cannot be determined from the labeling. The values for nitrogen-free extract and crude fat are probably of little value to most poultrymen. Nitrogen-free extract includes a group of carbohydrate substances which, for the most part, are readily digested and utilized by simple stomach animals (pigs and chickens). The higher the content of crude fat and nitrogen-free extract, the greater the energy content of the feed.

Crude fiber includes those carbohydrate substances (cellulose, lignin and hemicellulose) which make up the cell walls and woody material of plants. Poultry make very little or no use of crude fiber. In fact, rations for growing birds should contain relatively low levels of fiber, usually less than 8 percent. The energy content of poultry rations is probably more important than the fiber content; generally a medium or high energy ration will be low in fiber content.

Various other useful information such as the content of calcium, phosphorus, salt and iodine may also be found on the feed tag.

Table 1. Complete feed formulas for starting chickens and growing pullets.

Ingredient	0-6 wk Starting chickens	7-14 wk Growing pullets	14-21 Developing pullets
	% or lb per 100 lb		
Cround yellow corn	56.35	24.05	24.05
Ground milo	-----	20.2	28.2
Wheat shorts or middlings	-----	35.0	35.0
Soybean meal (50% protein)	24.2	7.0	1.5
Meat and bone scrap (50% protein)	2.5	4.0	1.5
Fish meal (60% protein)	2.5	-----	-----
Dehy. alfalfa meal (17% protein)	5.0	5.0	5.0
Dried whey	2.5	2.5	2.5
Dicalcium phosphate or defluorinated phosphate	1.0	1.0	1.0
Ground limestone	0.5	-----	-----
Salt (NaCL)	0.4	0.4	0.4
Trace mineral mix[a/]	0.05	0.05	0.05
Vitamin premix[b/]	1.0	0.8	0.8
Coccidiostat	2.0	-----	-----
Animal or vegetable fat	2.0	-----	-----
Total	100.00	100.00	100.00

[a/] Trace mineral mix should provide the following per ton of complete chick starter feed: 40 grams manganese, 40 grams iron, 4 grams copper, 1.4 grams iodine and 50 grams zinc.

[b/] Vitamin premix should provide the following per ton of complete chick starter feed: 3,000,000 I.U. stabilized Vitamin A, 1,000,000 I.C. units of vitamin D_3, 10,000 I.U. Vitamin E, 3,200 mg menadione sodium bisulfite, 20,000 mg niacin, 6,000 mg Ca-pantothenate, 3,000 mg riboflavin, 8 mg Vitamin B_{12}, 300,000 mg choline chloride, 4-10 grams antibiotic supplement and 1.25 lb DL-methionine or methionine hydroxy analog.

Calculated composition:

Protein, %	21.4	16.65	14.4
Metabolizable energy, Cal/lb	1309	1090	1100
Productive energy, Cal/lb	950	811	815
Methionine, %	0.52	0.38	0.35
Methionine and cystine, %	0.83	0.63	0.60
Calcium, %	1.11	0.82	0.75
Total phosphorus, %	0.75	0.75	0.75
"Avail." phosphorus, %	0.51	0.45	0.45

Table 2. Complete feed formulas with a 3.0 percent calcium level for laying chickens.

Ingredient	*Protein level, %*		
	14.5	*16.0*	*18.0*
	% or lb per 100 lb		
Ground yellow corn	37.5	35.65	33.25
Ground milo	37.4	35.6	33.2
Soybean meal (50% protein)	10.35	14.0	18.8
Meat and bone scrap (50% protein)	5.0	5.0	5.0
Dehy. alfalfa meal (17% protein)	2.5	2.5	2.5
Ground limestone	5.0	5.0	5.0
Dicalcium phosphate or defluorinated phosphate	1.25	1.25	1.25
Salt (NaCL)	0.4	0.4	0.4
Trace mineral mix[a/]	0.05	0.05	0.05
Vitamin premix[b/]	0.5	0.5	0.5
DL–methionine or methionine hydroxy analog	0.05	0.05	0.05
Total	100.00	100.00	100.00

[a/]Trace mineral mix should provide the following per ton of complete feed: 30 grams manganese and 40 grams zinc.

[b/]Vitamin premix should provide the following per ton of complete feed: 5,000,000 I.U. stabilized Vitamin A, 1,600,000 I.C. units Vitamin D_3, 10,000 I.U. Vitamin E, 5,000 mg riboflavin, 8 mg Vitamin B_{12}, 8,000 mg Ca-pantothenate and 454,000 mg choline chloride.

Calculated composition:

Protein, %	14.5	16.0	18.0
Metabolizable energy, Cal/lb	1331	1317	1298
Productive energy, Cal/lb	1007	989	966
Methionine, %	0.30	0.34	0.36
Methionine and cystine, %	0.52	0.57	0.62
Calcium, %	2.93	2.95	2.95
Total phosphorus, %	0.74	0.77	0.77
"Avail." phosphorus, %	0.56	0.56	0.56

Table 3. Complete feed formulas with a 3.5 percent calcium level for laying chickens.

Ingredient	*Protein level, %*		
	14.5	*16.0*	*18.0*
	% or lb per 100 lb		
Ground yellow corn	36.45	34.65	32.15
Ground milo	36.6	34.7	32.3
Soybean meal (50% protein)	10.6	14.3	19.2
Meat and bone scrap (50% protein)	5.0	5.0	5.0
Dehy. alfalfa meal (17% protein)	2.5	2.5	2.5
Ground limestone	6.6	6.6	6.6
Dicalcium phosphate or defluorinated phosphate	1.25	1.25	1.25
Salt (NaCL)	0.4	0.4	0.4
Trace mineral mix[a/]	0.05	0.05	0.05
Vitamin premix[b/]	0.5	0.5	0.5
DL—methionine or methionine hydroxy analog	0.05	0.05	0.05
Total	100.00	100.00	100.00

[a/]Trace mineral mix should provide the following per ton of complete feed: 30 grams manganese and 40 grams zinc.

[b/]Vitamin premix should provide the following per ton of complete feed: 5,000,000 I.U. stabilized Vitamin A, 1,600,000 I.C. units Vitamin D_3, 10,000 I.U. Vitamin E, 5,000 mg riboflavin, 8 mg Vitamin B_{12}, 8,000 mg Ca-pantothenate and 454,000 mg choline chloride.

Calculated composition:

Protein, %	14.5	16.0	18.0
Metabolizable energy, Cal/lb	1306	1292	1273
Productive energy, Cal/lb	988	970	945
Methioine, %	0.30	0.34	0.36
Methionine and cystine, %	0.52	0.57	0.62
Calcium, %	3.52	3.54	3.50
Total phosphorus, %	0.74	0.77	0.77
"Avail." phosphorus, %	0.56	0.56	0.56

Table 4. Concentrate and grain mixtures for complete rations.

		A	*B*	*C*
		Lb	*Lb*	*Lb*
Concentrate (26% protein)		350	350	300
Ground corn		325	250	200
Ground milo		325	250	200
Pulverized oats			150	100
Ground wheat				200
	Total, lb	1000	1000	1000
	Protein, %	15.6	15.9	16.0

		A	*B*	*C*
		Lb	*Lb*	*Lb*
Concentrate (32% protein)		300	300	250
Ground corn		700	350	300
Ground milo			350	300
Pulverized oats				150
	Total, lb	1000	1000	1000
	Protein, %	15.8	16.2	15.8

		A	*B*	*C*
		Lb	*Lb*	*Lb*
Concentrate (38% protein)		250	220	200
Ground corn		750	390	325
Ground milo			390	325
Pulverized oats				150
	Total, lb	1000	1000	1000
	Protein, %	16.1	16.2	15.9