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EC1420 Revised 1933 Better Rations - More Eggs

F. E. Mussehl

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W. H. Brokaw, Director, Lincoln

Better Rations-More Eggs

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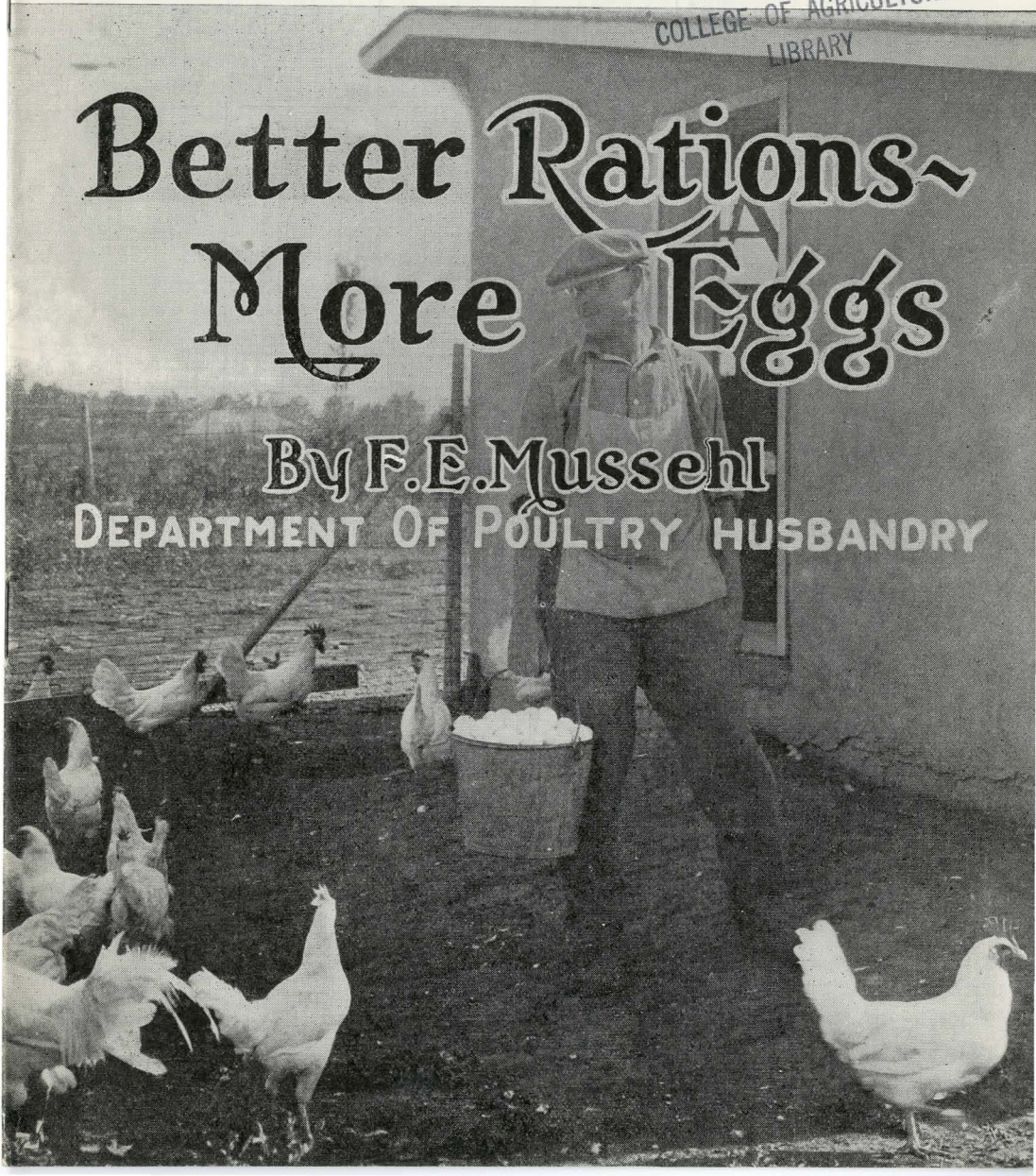

VITAMIN CHART (For Poultry)

Vitamin	Functions	Results of Deficiency	Most Reliable Sources	Birds' Requirements Satisfied Normally	Stability
A (Fat soluble)	Promotes growth and health. Prevents infections, notably of eyes, sinuses, air passages and lungs.	Loss of appetite. Cessation of growth. Opthalmia or nutritional roup develops.	Yellow corn, cod liver oil, sardine oil, egg yolk, butterfat. Thin green leaves, especially alfalfa. Active growing parts of green plants, yellow carrots, spinach.	40 per cent yellow corn in ration or green feed at rate of 5-6 lbs. per 100 hens per day, or 6 to 10 per cent alfalfa leaf meal in mash.	Relatively stable to high temperature. Destroyed by oxidation, but not easily.
B Complex (F plus G) or (B_1 plus B_2) (Water Soluble)	Stimulates appetite. Promotes growth and health. Aids digestion. Protects against polyneuritis.	Impairment of appetite, retarded growth, loss of weight and vigor. Enlargement of adrenals. Decrease in size of many internal organs and glands, including the reproductive. Polyneuritis results from lack of the antineuritic factor.	Whole grains, especially the outer covering and germ. Wheat shorts, bran, alfalfa, cabbage, spinach, dried milk products, yeast.	20 per cent wheat shorts and bran, green feed of all kinds, dried milk products.	Resistant to oxidation. 250° F. for two hours destroys the anti-neuritic factor.
C	Can be synthesized by bird.	Lack of C results in scurvy in humans.	Tomato juice, orange juice, lemon juice.		Destroyed by heat.
D (Fat Soluble)	Affects calcium and phosphorus assimilation and fixation. Protects against rickets.	Rickets, osteoporosis. Bones weakened. Laying hens produce soft shelled and shellless eggs.	Cod liver oil, other fish oils, egg yolk. Ultra violet radiation. (310 to 290 mu.) Irradiated ergosterol.	Normal ration plus one per cent of cod liver oil or direct sunlight or other ultra violet radiation.	Quite stable.

Better Rations — More Eggs

F. E. MUSSEHL

Well-bred and well-fed hens are conceded to be economical producers of a very wholesome food product, eggs,— but hens are not miracle workers and they insist on the right kind of raw material for building the egg. Nebraska's poultry growers fortunately have all the natural feeds—corn, wheat, oats, barley, and dairy and packing house by-products—readily available at lower cash prices than prevail in most other states, and so Nebraska's special problem is that of combining them so that eggs may be produced at the lowest cost per dozen.

FEEDING PRINCIPLES

Prices of particular feeds may vary, and as they do, it is sometimes good business policy to vary our mixtures. This we can do safely if we meet certain requirements.

The principles of feeding can best be demonstrated by considering corn as a poultry feed. Corn is, in fact, the basic poultry feed in most sections because of its high palatability, digestibility, and reasonableness of cost. But hens put on a ration of corn alone will not lay eggs, because such a ration is deficient in minerals, in proteins of the right quality, and probably also in some of the vitamins.

If we re-enforce the corn ration with minerals, our hens will lay a few eggs but not many because the ration is still very deficient. When we add to the corn and minerals some good complete animal protein, as is furnished by milk or packing house products, egg production is much improved but is still not at its best. The addition of some succulent green feed like clover will, however, further improve egg production.

The principles of feeding can be represented quite fairly in a table of additions as follows:

	Symbols represent increasing egg production
I. Corn alone	0
II. Corn+ash (mainly calcium, phosphorus, and chlorine furnished by salt)	+
III. Corn+ash+animal protein	+++
IV. Corn+ash+animal protein+green feed	++++
V. Corn+ash+animal protein+green feed+other feeds which add palatability and attractiveness	++++++

Practically all grains and grain products are deficient in the same essentials as corn, so that combining grains, tho helpful, does not entirely solve our feeding problem.

VITAMIN REQUIREMENTS OF POULTRY

The term, vitamins, includes a group of substances, the chemistry of which is as yet but little understood. Their importance, however, can be demonstrated very easily by putting hens or chicks on rations which are deficient in these elements. Seven members of this nutrient group are now recognized, these being designated by the letters of the alphabet, viz., A, B, C, D, E, F, and G. There is evidence that vitamins A, B, and D are of great importance to poultry. Vitamin C can be synthesized by the hen and is therefore not needed in the ration, and only limited experimental work has yet been reported on the E, F, and G requirements of birds.

Vitamin A is one of the fat soluble vitamins. Its chief influence is to promote growth, and since egg production is really a growth phenomenon, it is naturally very important in the laying hen ration. A lack of this vitamin affects the secretory glands of the eye, nose, throat, and mouth and results in a condition known as xeropthalmia. The secretions of these glands have a bactericidal value and infections of the eye and head are more common when the ration is deficient in this vitamin. Nutritional roup, which is the name given to the resulting condition, can be prevented and cured with rations which are rich in the vitamin A factor.

Egg yolk, butterfat, yellow corn, the green leafy portion of most plants, alfalfa hay and meal, carrots, and millet are rich in this element. Certain of the animal tissues, notably those of the liver, carry it, and cod liver oil is one of the richest sources. This vitamin is slightly unstable when exposed to the air, particularly at high temperatures, and consequently when cod liver oil is being fed for its "A" content it should be mixed every week or ten days for best results.

Vitamin B (B_1), or water soluble factor, is in some way correlated with the functioning of the nervous system. Rations deficient in this vitamin result in the disease known as polyneuritis, evidences of which are paralysis of the neck and limbs.

This vitamin is the most widely distributed of them all, and furthermore is quite stable with respect to drying. It is found in the germ and bran layer of all grains, in green food, milk, and egg yolk. It is found in greatest concentration in yeast, wheat shorts, and bran; the latter products generally furnish the most practical supply of this essential.

Vitamin C, the antiscorbutic or scurvy-preventing vitamin, is not essential in the hen ration, but can apparently be manufactured by the hen.

Vitamin D is the antirachitic or rickets-preventing element. Rickets is a disorder that is due to faulty calcium and phosphorus assimilation. In some manner not yet perfectly understood, the vitamin factor contained in egg yolk and cod liver oil influences the assimilation of calcium and phosphorus and conserves the supply in the blood stream. Certain light rays have the same effect, these rays being known as the ultra violet. Nebraska's experimental work with chicks indicates that when direct sunshine is available for an average of 20 minutes per day, that vitamin D additions are unnecessary with any ordinary ration. During the winter months and during periods of prolonged cloudy weather, however, the providing of vitamin substitutes for radiant energy is advisable.

Cod liver oil is probably the most practical source of vitamin D, although recent research work indicates that certain other fish oils are also rich in this factor. There is still some debate as to the relative value of different grades of oils, and it is unfortunately very hard to standardize or determine their nutritive value. The general conclusion is that the light lemon colored oils are higher in vitamin content than are the darker oils.

Cod liver oils with a low fatty acid content are preferable to those having a high fatty acid content. Cod liver oil can be mixed with the dry mash ingredients, about one pint per 100 pounds of feed being sufficient. It can be worked into the mixture with the hands or it can be warmed slightly and added with a sprayer as the mash is being mixed. Vitamin D is much more stable than vitamin A with respect to oxidation.

A by-product of the making of cod liver oil known as cod liver meal is also being offered as a high vitamin D feed. The high vitamin content of this feed has not yet been definitely established, and until more research work has been done the University advises the use of cod liver oil as the source of this essential.

Vitamin E is the last of these elements to be discovered, and its necessity in the diet for hens has not yet been established. It is found in many plants and in the germ portion of most seeds.

PROTEIN REQUIREMENTS

The word, protein, is derived from a Greek word meaning of the first importance. Neither growth, egg production, nor maintenance are possible on a ration lacking protein, and so this element is truly of first importance.

Proteins are very complicated substances built up of simpler compounds which are known as amino acids. Certain of these amino acids are more important from the standpoint of feeding practice than are others, and some of the important ones are lacking in the proteins from plant sources. For this reason best results are obtained when the laying hen ration contains at least some animal protein material like meat scraps, tankage, skim milk, dried buttermilk, etc. The illustration (Figure 2) shows the remarkable effect on egg production which results from the addition of tankage and meat scraps to a typical grain ration. The addition of six pounds of a high grade tankage to the year's ration per hen increased egg production from 59 eggs per hen in the check pen to 183 eggs per hen in the tankage fed lot.

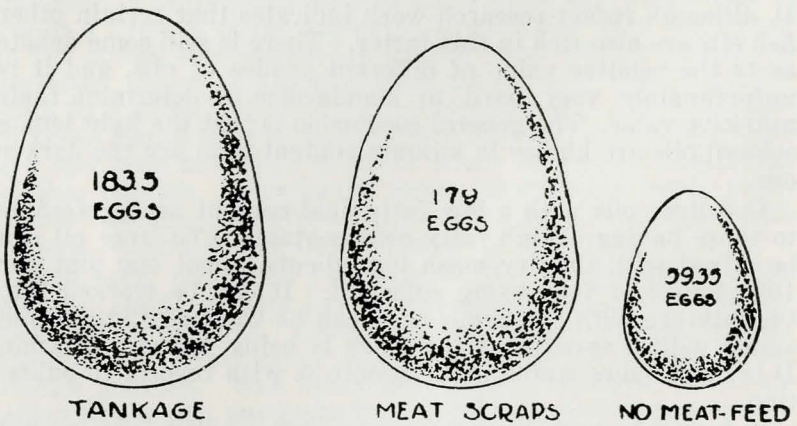

FIG. 1.—Comparative egg records of hens fed tankage, meat scraps, and no animal protein feed. From Circular 101, Purdue Agricultural Experiment Station.

Skim milk and buttermilk are also excellent sources of protein, and when these are available on the farms or can be purchased at practical prices, they should by all means be used. Milk contains other nutrients besides proteins, but when milk is used for the chief source of additional protein about 110 pounds of milk are needed per hen per year. About three gallons of skim milk per 100 hens per day will meet the supplemental protein needs when ordinary grain rations are used as the base.

Although it is not deemed advisable to rely on plant proteins for the main supplemental supply, nevertheless a share of these can be used, and if packing house by-products are hard to obtain and high in price, it is recommended that a

small quantity of cottonseed meal, linseed oil meal, corn gluten meal, soybean meal, and similar high protein plant products be used. When a mash mixture, for instance, calls for 15 per cent of meat meal, good results will also be obtained by using 10 per cent meat meal plus 5 per cent of soybean meal or cottonseed meal.

When soybean meal and cottonseed meal are cheaper in price than meat meal, a partial substitution of the meat meal with the products mentioned or of other high protein feeds is good business policy. When comparing the cost of protein feeds remember to take into account the difference in protein content of the various protein feedstuffs.

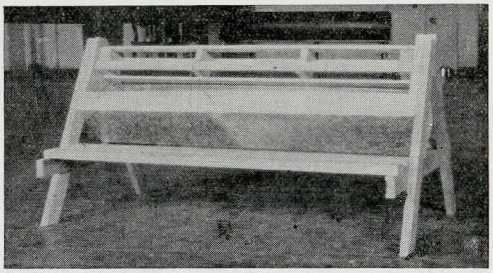

FIG. 2.—The trough type of dry mash feeder is easy to make of either metal or lumber. Two troughs five feet long with feeding space on both sides will serve for 100 hens.

FEED DRY MASH

A program for "150 eggs per hen" production must be planned around a good, complete dry mash mixture. Several satisfactory dry mash formulas are listed on the middle pages of this circular. The mash mixture, being made from ground grains, milling by-products, and usually packing house products, is less palatable because of its finely ground form than is the scratch feed. For this reason it is safe to keep it before the hens at all times without danger of overfeeding. The mash part of the ration is of special value as a carrier of supplemental protein and vitamin essentials.

GRAIN FEEDS

During recent years much has been written about the "all mash" method of feeding in which everything in the ration was put into one mixture. From the standpoint of convenience this system is quite ideal, but it also has some disadvantages. For one thing many poultry producers now realize that grinding and otherwise processing feedstuffs always costs money or effort. Hens eat whole corn, wheat, oats, and barley very readily, and they are equipped to grind these grains very efficiently in their gizzard mills. By feeding these grains whole, we save the processing cost without reducing the value of these feeds in the slightest degree.

TABLE I

Laying Mash Rations (1000 Mix)

FEEDS	Ration Numbers								
	101	102	103	104	105	106	107	108	109
1. Yellow cornmeal	200	340	340	340	340	290	340	340	240
2. Wheat shorts	200	200	200	200	200	200	200	200	200
3. Wheat bran	200	100	100	100	100	100	100	100	100
4. Pulverized oats	200	100	100	100	100	100	100	100	100
5. Pulverized barley	.....	.....	.....	.....	.....	.....	.....	.....	100
6. Alfalfa meal	.....	100	100	100	100	100	100	100	100
7. Meat scraps	200	150	100	100	50	50	100	100	100
8. Dried buttermilk	.....	.....	50	.....	50	50	.....	.....	.....
9. Fish meal	.....	.....	.....	.....	50	50	.....	.....	50
10. Soybean meal	.....	.....	.....	.....	.....	50	50	.....	.....
11. Cottonseed meal	.....	.....	.....	50	.....	.....	.....	.....	.....
12. Linseed oil meal	.....	.....	.....	.....	.....	.....	.....	50	.....
13. Salt	.....	10	10	10	10	10	10	10	10
Totals	1000	1000	1000	1000	1000	1000	1000	1000	1000

Add one gallon of cod liver oil per 1000 pounds of mash during the fall and winter months, and if the flock is closely confined, use cod liver oil throughout the year.

It is suggested that the above formulas be fed with grain on an equal parts basis. The following grain mixtures may be used:

NO. 1		NO. 2	
Whole yellow corn	700 lbs.	Whole yellow corn	400 lbs.
Wheat	300	Wheat	300
		Barley	300
	1000 lbs.		1000 lbs.

Winter Feeding Schedule

All Day: Dry Mash in Feeders
20 feet of feeding space per 100 hens
For breeders, 1 lb. cod liver oil per 100 lbs. mash

***5:00 a. m. Lights On**
Fresh water available

7:00 a. m. Germinated Oats
3 lbs. dry weight per 100 hens

10:30 a. m. Moist Mash
Feed in clean, protected feeder
Moisten mash with skim milk if possible

3:30-4:30 p. m. Scratch Feed
Cracked yellow corn, 5 to 8 lbs. per 100 hens
Enough to keep up body weight but not make birds overfat

After birds have gone to roost:
4 pounds wheat per 100 hens for morning feed

When weather permits:
Windows open daily to obtain benefits of direct sunshine

* If lights are not used, feed scratch lightly first thing in morning and germinated oats one hour later. Use no lights or at most very moderately on birds to be used for breeders.

When a good mash mixture is used, a relatively simple grain mixture will be satisfactory. When corn and wheat are of approximately equal value about equal parts can be used. When corn is cheaper than wheat somewhat more corn should be used. One can even save the labor of mixing the grain ration by feeding the wheat in the morning and the yellow corn late in the afternoon before the birds go to roost.

When the mash carries from 20 to 22 per cent of protein the ratio of grain to mash should be about 60 pounds of grain to 40 pounds of mash. Since the grains are more palatable there will be no difficulty in adjusting the grain to mash ratio as desired.

SUCCULENCE AND WATER

Succulent feeds like alfalfa, clover, blue grass, sprouted oats, etc., are rich in the vitamins which have assumed great importance as knowledge of feeding essentials has increased. These feeds have a good effect on the digestive system and many poultrymen are finding succulent feeds more beneficial than drugs and tonics in this respect.

Alfalfa hay and alfalfa meal are not exactly succulent feeds, but they contribute some of the same essentials to the ration and should be used whenever available. A good grade of third or fourth cutting alfalfa hay may be fed in a simple rack or feeder and may be kept before the hens at all times during the fall and winter months. Alfalfa meal may also be included in the dry mash mixture in quantities up to ten per cent. When more than this is included the palatability of the mash mixture is lowered, and as a matter of practice the amount of alfalfa meal is usually limited to from 6 to 8 per cent.

Since only a small quantity of alfalfa is needed per bird, and since alfalfa is used chiefly for its vitamin content, emphasis should be placed on getting a high quality product. High vitamin content is associated with good green color, high leaf percentage and low fibre content. Leafy alfalfa always contains more protein and less fiber than the coarse, stemmy product. The chemical analysis, together with the color, quite accurately indicates the nutritive value of any particular sample of alfalfa meal product. For poultry feeding alfalfa meal should contain at least 18 per cent of protein and not to exceed 23 per cent of fiber, and should carry a good green color. Alfalfa meal will be consumed more readily if ground quite fine. Hammer mills are usually used for grinding the meal, the custom charge for this ranging from 15 to 25 cents per 100 pounds.

FIG. 3.—Oats and barley can be sprouted easily in candy pails or lard tubs. Expensive equipment is not necessary.

Sprouted oats are one of the best forms of succulence, and these can be prepared very easily without buying expensive equipment. At the Agricultural College Poultry Farm the box method of sprouting is used. The oats are soaked in a large tub or barrel for about 12 hours. They are then drained and shoveled into shallow boxes to a depth of 3 to 4 inches, water being sprinkled over them as they become dry. In a basement room in which the temperature can be kept between 50 degrees and 80 degrees Fahrenheit, sprouting proceeds rapidly, and the oats are ready to feed in five days. The hens like them best when the sprouts are about one-half inch long. Mangel beets, sugar beets, and similar root crops can be used as succulent feeds, but recent experimental work at the California Experiment Station indicates that they are not as valuable as field grown greens. Carrots are, however, considered the equal of field grown greens.

A dozen eggs contain about a pint of water, and a hundred hens in good production will require about four gallons of water per day. Good, clean, fresh water should be available at all times.

MINERAL FEEDSTUFFS

The mineral requirements of good laying hens are relatively great, the completed egg containing about eleven per cent of ash, most of which is calcium carbonate. The calcium can

usually best be furnished in the form of oyster shell or high grade limestone crushed to approximately the size of whole barley. A small amount of pulverized limestone may be added to the mash mixture, but this should not exceed three per cent as a maximum. Even when a small amount of pulverized limestone is included in the mash formula we recommend keeping oyster shells or crushed limestone in a box or hopper before the hens at all times. Hens in full production require more calcium than those that are resting, and the free choice enables the hens to adjust the supply to their needs at any particular period.

Another mineral which hens need in small amounts is common salt. The only safe way to feed this element is to add the finely granulated product to the mash mixture. One pound of salt per 100 pounds of mash is recommended.

FIG. 4.—The dry mash ingredients can be well mixed by turning them over on the floor about four times. Whether to buy prepared feeds or mix rations at home is a question of cost, quality, and convenience. Figure the cost of the ingredients in the ration, add a reasonable charge for mixing, and then compare the price of home mixed feeds with commercial feeds.

Other mineral elements which are needed in much smaller amounts are phosphorus, potassium, sulphur, magnesium, iron, iodine, and manganese. These elements are provided in sufficient amounts in the grain and meat products which are ordinarily used for poultry feeding so that we need not be concerned with them as a practical problem. The addition of the so-called complete mineral mixtures to laying hen rations is of very doubtful value, and is not recommended by this Experiment Station. The essential mineral supplements can be provided at a low cost in the form of products already referred to above.

ARTIFICIAL LIGHTING IN WINTER

Winter egg production can be considerably increased by artificial lighting. Two flocks of 90 Leghorn pullets each were given the same kind of feed and were housed in the same kind of poultry houses at this Experiment Station. One lot was, however, lighted from 5 A. M. until daylight. The lighted lot laid 3,407 eggs during the same time that the unlighted birds laid 2,559. The additional eggs produced by the lighted flock during the period of lighting (from December 18 to March 1) sold for $25.44.

Lights are used of course only during the fall and winter months, when the hen's working day is comparatively short. The lighting period covers a time from October 1 to March 1 each year, and well developed pullets which are ready to start laying about November 1 usually respond best to lighting. When lights are used on yearling hens their use should be postponed until about January 1.

Two common methods of lighting are practical, these being morning lights (from 4:30 A. M. until daylight) and evening lights (from sunset to about 9:00 P. M.). Morning lighting seems to give best general satisfaction because of greater ease in working out a feeding and management schedule. The morning feed of scratch grain can be thrown in the litter the evening before and an alarm clock operated switch will turn on the lights at the desired time. The points which must be emphasized when lights are used are regularity in their use, proper feeding, and a good supply of water.

TOTAL FEED REQUIREMENTS

Accurate records which have been kept at the Vineland, New Jersey, Egg Laying Contest indicate that birds of the general purpose type, Plymouth Rocks, Reds, and Wyandottes, will consume about 85 pounds of feed per bird per year. Leghorns consumed 76 pounds per bird. The pounds of feed required to produce a pound of egg were 4.6 for the general purpose breeds and 3.5 for the Leghorns.

It is estimated that, with good birds given good care so that the total annual production averages 150 eggs per hen, a $10.00 per ton fluctuation in feed prices represents a fluctuation of 3½ cents per dozen in the cost of the eggs produced. In other words, when feed goes up $10.00 per ton eggs must sell for 3½ cents per dozen more, to make the same labor and managerial income.

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TABLE II.—*Average Composition of Commercial Poultry Feedstuffs* *

Feedstuff	Water	Ash	Crude Protein	Crude Fibre	N. Free Extract	Fat
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Wheat	12.0	1.8	12.0	2.6	69.7	1.9
Corn Dent (No. 2 grade)	14.4	1.4	9.8	2.1	67.6	4.7
Wheat Bran	10.0	6.2	15.9	9.8	53.6	4.5
Wheat Shorts	10.0	4.3	17.3	6.9	56.4	5.1
Wheat Mixed Feed (bran and shorts)	10.0	5.2	16.7	7.9	55.6	4.6
Oats	10.0	3.1	12.3	9.1	60.7	4.8
Oats (sprouted 5 days)	51.5	2.2	4.8	7.5	32.6	1.6
Oatmeal	8.0	2.0	15.2	1.3	67.5	6.0
Barley	11.2	2.2	11.4	5.2	67.8	1.9
Emmer	8.2	3.8	11.6	11.0	63.0	2.1
Rye	10.4	2.0	11.7	1.7	72.8	1.7
Millet	8.2	3.1	27.4	12.3	44.3	5.5
Kafir	10.3	1.6	10.1	2.0	72.2	2.9
Buckwheat	12.1	2.0	10.8	10.5	61.3	2.4
Soy Beans	10.1	5.2	35.6	4.7	26.9	17.4
Cowpeas	12.3	3.3	21.8	4.1	55.7	1.5
Sunflower Seed	7.9	2.9	16.2	29.3	22.2	21.0
Corn Gluten Feed	8.9	2.2	24.9	7.0	52.8	3.7
Corn Gluten Meal	9.0	1.4	35.4	2.0	48.2	4.5
Linseed Oil Meal (O.P.)	9.2	5.3	33.6	7.9	35.2	7.6
Linseed Oil Meal (N.P.)	9.7	4.9	37.2	8.6	36.2	2.8
Cottonseed Meal	7.8	6.5	38.6	10.3	30.2	6.6
Alfalfa Meal	8.9	9.1	16.4	29.1	33.2	2.3
Alfalfa Leaf Meal	8.1	12.9	22.6	12.4	40.6	3.2
Meat Meal	8.9	16.9	60.8	1.8	4.1	6.8
Meat and Bone Meal	8.8	23.4	53.8	2.1	3.8	6.5
Blood Meal	9.8	3.2	81.6	.....	3.5	1.0
Raw Bone Meal	7.5	59.0	25.2	1.8	3.7	3.1
Steamed Bone Meal	8.5	66.1	17.9	1.9	2.8	1.8
Green Cut Bone	31.1	19.3	21.9	.....	3.0	23.1
Fish Meal	9.5	28.9	53.1	.....	.....	8.0
Cod Liver Meal	4.9	2.9	40.6	.....	14.9	40.8
Skimmilk	90.1	0.7	3.8	.....	5.2	0.2
Buttermilk	90.5	0.7	3.7	.....	5.0	0.1
Cottage Cheese	72.0	1.8	20.9	.....	4.3	1.0
Dried Buttermilk	11.5	9.1	31.1	.....	41.9	6.1
Semi-Solid Buttermilk	65.1	2.8	13.3	.....	15.7	3.1
Mangel Beets	90.6	1.0	1.4	0.8	6.0	0.1
Carrots	88.2	1.2	1.1	1.1	8.1	0.2
Potatoes	78.7	1.1	2.2	0.4	17.5	0.1
Cabbage	91.0	0.8	2.2	0.9	4.8	0.3
Oyster Shell		95.7 $CaCO_3$				

* Averages determined from analyses reported by State Feed Control Laboratories, Agricultural Experiment Stations, and United States Department of Agriculture.