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Feeding for Hatchability

Principles of feeding breeding fowls for increased production

H. L. Wilcke, B.S., M.S., Ph.D.*

The Poultry Industry, since its products were designated as essential foods for the Defense Program by Secretary of Agriculture Wickard, has been expanding to meet the requests for increased production in April, 1941. Secretary Wickard asked for an increase in both poultry and egg production, accompanying this request with a guarantee of a minimum price of 22 cents per dozen for eggs and 15 cents per pound for poultry. Poultry producers accepted the challenge promptly, and as a result, 1,052,468,000 chicks were hatched in the United States in 1941. This represented an increase of 17 per cent over the previous record hatch of 1939 and 28 per cent over the number hatched in 1940. Much of the demand for chicks, however, came late in the season and many of these late hatched chicks were still on the farms late in the fall. As a result about two-thirds of the poultry in the middle-western states was marketed in about three or three and one-half months. It is hoped that this situation has been avoided this year by increases in the number of early chicks purchased, that is, February and March chicks.

Increased Egg Production

For 1941 the Government set up the goal of a 7 per cent increase in egg production over 1940. For 1942 an additional increase of 13 per cent in farm egg production has been requested. This brings the total desired production for 1942 up to 4,200,000,000 dozens. This increase can be accomplished in either one of two ways; by an increase in production per bird through improved feeding, management, and housing, or by an increase in numbers of laying hens kept on farms. Obviously, the former method is preferable, not only because there has been a sharp rise in feed price but also because it is necessary to conserve feed supplies for all types of food production. This applies particularly to protein and vitamin concentrates. Certainly there is ample opportunity for improvement in efficiency of production and in increasing the average production per bird when we consider that the average production per laying hen for the entire United States was about 101 eggs in 1940, the highest average production on record. The average production for Iowa has not kept pace in the last few years. This means that there is a definite need for improvement in Iowa because we are not getting the performance that the hens would be capable of under more favorable conditions. Space will not permit a complete discussion of feeding and management factors. Information on housing will be available in extension publications on that subject.

Adequate floor space should be provided to avoid crowding. This means that Leghorns and other light breeds should have a minimum of three square feet of floor space per bird and that American breeds and heavier birds should have a minimum of three and one-half square feet of floor space.

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space per bird with four square feet for the very heavy breeds. One of the real dangers of the increase in production is crowding, particularly in laying houses. There should be not less than four inches of hopper space for mash and grain, one inch of drinking space, eight inches of roosting space for each bird, and there should be one nest for each five birds.

Sanitation may be improved greatly by confining the birds to the laying house or providing sun porches or gravel yards when they are allowed out of the house.

Efficiency of Feed

The cost of feed amounts to 55-60 percent of the total cost of egg production when all costs including labor are recorded. This means that anything that can be done to improve the efficiency of the feed will have a decided effect on the cost of egg production. For the breeding flock this is effective, not only in reducing initial cost of eggs but also in affecting the egg cost of chick production by increasing the hatchability or, stating it the other way, by decreasing the number of eggs required to produce each 100 chicks. It is ordinarily assumed that for each 100 eggs set there will be on the average 65 to 67 chicks hatched. Translating this into terms of the number of chicks hatched during 1941 there was a probable waste of 526,234,000 eggs which were set in incubators but which did not hatch. Obviously it is improbable that we will get 100 per cent hatches at any time in the near future, but any increase that can be secured in hatchability will affect the number of eggs available for food; consequently, this number will affect any increases that we must have in our egg supply. Therefore, it is important that the laying flocks be fed the most complete rations possible to produce the maximum number of hatchable eggs. In most cases the requirements for egg production are the same qualitatively as the recommendations for hatchability, but the quantitative requirements are, for the most part, higher for hatchability than for egg production. Therefore, any ration that will produce eggs with high hatchability will also produce eggs most efficiently from the feed use standpoint.

Protein Supplements

One of the most important items in the diet for the laying hen is the protein supplement. Research at various experiment stations has demonstrated that maximum egg production is obtained when the total ration of the laying hen contains 16 to 19 per cent protein, depending upon the source. This means that our farm grains must be supplemented with more concentrated protein supplements to bring the protein level of the total ration to the necessary level. Increased demands for protein supplements, not only for poultry and egg production, but also for other types of livestock production have made the protein supplement situation critical from the standpoint of supplies and prices. This situation has become sufficiently important that Mr. Leon Henderson of the O.P.A. on January 20 announced ceilings on the prices of fish meal and packing house by-products. The ceilings were based upon the general level of prices prevailing on January 17, and they are to continue in effect for sixty days from the time that the ceilings were set. This was the first action of this kind to be taken on feed products and it illustrates the importance of the situation.

Animal Protein Supplements

As a rule protein supplements for poultry feeding are divided into the two general classes of animal and vegetable proteins. In the animal proteins, milk and milk products have been used extensively, and milk is considered as the standard protein supplement by which other proteins are judged. The biggest demand for feeding milk comes from the poultry feed industry; consequently the poultry industry has been affected most by the diversion of milk from the animal feed trade, caused chiefly by Government purchases of milk for human consumption, and also by the expanded demand for casein for cheese and other milk solids.

Milk is used in several forms in practical poultry feeding. It is fed as liquid
skimmilk or buttermilk, condensed skim-milk or buttermilk, and dried skimmilk or buttermilk. In research done on these forms of milk, it has been found that one form of milk is equal to any other form on an equal solids basis, with the exception that buttermilk in general is somewhat higher in riboflavin than the skimmilk products. This means that one pound of dried milk is equivalent to approximately three pounds of the condensed product or nine to ten pounds of the liquid, and also that one pound of condensed milk is equivalent to three pounds of liquid. The dried milk contains from 34 to 35 per cent protein and the condensed product from 11 to 12 per cent. Thus substitutions from the protein standpoint alone are not so difficult; but milk, in addition to protein, carries a number of the vitamins, particularly the water soluble vitamins, which are essential and which must be replaced if milk is to be omitted from the poultry ration.

**Other Animal Proteins**

Other animal protein supplements that are used commonly are fish meal, and the meat by-products. Fish meal carries 55 to 70 per cent of protein with the usual product in the upper range, that is 65 to 70 per cent. The better grades of fish meal are of exceptionally high biological value. This product has been used extensively on both the east and west coasts, and in recent years it has become increasingly popular in the Middle West. While the price may seem high, it is quite frequently a very economical source of protein when composition and biological value are considered. In the case of the better fish meals the protein may be of equal or even higher biological value than the proteins we find in milk. The meat by-products most frequently used are meat scraps (55 per cent protein) and meat and bone meal (50 per cent protein). These products are used in preference to tankage because they are usually more uniform in composition and because they do not carry blood meal or stick which are not palatable to poultry and are not used efficiently. Liver meal is also used as a protein supplement and as a vitamin supplement, but the supply of this product seems to be very limited. A combination of several protein sources is the most efficient because of the supplementary action of the amino acids in the various proteins. Thus, a combination of fish meal, meat and bone meal, milk, and soybean oilmeal has been found to be more efficient than any one of these supplements alone when used to supplement farm grains. The amounts required depends upon the proportions and types of grains used.

**Vegetable Protein Supplement**

Among the vegetable proteins, soybean oilmeal is used the most widely, and it has been found to be one of the best of the vegetable protein supplements. It has one objection in that soybeans have a goitrogenic property. To offset this, it has the advantage of being one of the best natural sources of choline which has been found to be essential for growth and egg production. Corn gluten meal is also used extensively in poultry feeding, and this product has the advantage of carrying vitamin A as well as protein. Cottonseed meal and peanut meal have been used more extensively in the southern states, but recent developments have encouraged their use throughout the country and they are being used more extensively in poultry feeds at the present time. Distillers dried grains with solubles have come on the market recently as protein supplements. These products contain 28 to 30 per cent protein, and they are by-products of the distillation industries. These products are used for their vitamin content and also as protein supplements.

**Vitamin A**

The vitamins that ordinarily are considered in making up practical poultry rations are A, D and B₂ (riboflavin). Many other vitamins are required by the chicken but for the most part these are supplied in the ingredients that are recommended or included for other purposes. Vitamin A (Continued on page 102)
KIMBER (Continued from page 69)

kept. In addition, 524 other families, unbroken for from two to five years, constitute 10,000 more pedigreed birds. All mortality in these families has been recorded as well as livability and soundness. These factors are thought to be more important than the measurement of egg production, but every female is trapped for egg production and egg size; precise measurement of shell, yolk, and albumen of the egg are made and recorded.

Kimber scientists are working on approximately forty separate and distinct research problems. As an aid to the solution of these problems, every bird which has died on the farm since 1934 has been necropsied. Dr. H. R. Brewer, veterinary pathologist, is in charge of this phase of the work.

One of the early problems of the farm was to attain a higher degree of biological soundness than that possessed by the foundation stock, even though some of the birds were from the world's best. A difficult problem was the outbreak of range paralysis (leucosis), which caused grave concern for three years. The reduction of the incidence of leucosis in the main population was accomplished by careful selection. At present, the most interesting problem is the development of a leucosis-free strain. Should such a strain actually be produced, as cancer-free strains have been in mice, it would constitute one of the greatest achievements in poultry breeding. Another problem is an attempt to develop a "pause-free" strain—that is, a reduction of the winter pause in laying hens.

The Kimber Farm is only part of America's billion dollar poultry industry, but much credit should be given it as it represents an establishment in business not only for itself but for the American poultryman. Scientific breeding on a large scale greatly benefits the farmer, and especially the commercial poultryman who is interested in the problems of breeding, feeding and management.

As was pointed out at the Seventh World's Poultry Congress held in Cleveland, Ohio in 1939, disease is the most important problem of the poultry industry today. The United States Bureau of Agricultural Economics estimated that in the average year of 1937 over 15 per cent of the 420,250,000 adult chickens in the United States died of some disease. This loss of adult birds, exclusive of chick and young stock losses, cost the poultry industry 48 million dollars in a single year. It can be seen why the poultry industry is seeking the help of the veterinary profession.

The Kimber Farm is an example of how the veterinarian can help the poultry industry. While every poultry raiser cannot operate upon the scale of the Kimber establishment, the principles of management are the same. As the Kimber Farm has utilized the knowledge gained by scientific research and practical experience, so can any poultry raiser. It is a matter of good business. The veterinary profession today should be ready to supply the poultry industry with all available information it has concerning poultry disease. That is good business too.

FEEDING (Continued from page 75)

is necessary for egg production, for hatchability, for the prevention of infections of the respiratory system and intestinal tract and for growth and general well being in chicks. The vitamin A potency of a product is measured in terms of international units. The international unit of vitamin A is the growth promoting and xerophthal mia preventing potency of 0.0006 milligrams of pure beta carotene. Vitamin A may be present in either one of two forms. It may be present as vitamin A itself; this form is found in animal products, or it may be found in the form of one of the caroten es which are recognized as provitamin A. It is usually found in this form in the vegetable sources. This vitamin is not stable, and fresh supplies of feed should be mixed frequently in order that the vitamin A potency may be retained.

The chick requires 1000 to 1200 International units of vitamin A per pound of feed. The laying hen requires approximately twice that amount or 2000 to 2400 units, and for maximum hatchability breeders should be fed up to 4750 units.
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Red Heart Dog Biscuits furnish abundant supplies of Vitamin A, Vitamin B Complex, Vitamin D, Vitamin E, essential unsaturated fatty acids, calcium, phosphorus, iron, copper, iodine, other trace minerals.

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CONTAIN ALL ESSENTIAL VITAMINS AND MINERALS

Red Heart Dog Biscuits include meat and bone scraps, marrow meat and bone, fresh meat, dry skimmed milk, fresh egg yolk, cereals, malt, wheat germ. Each package has 3 delicious flavors—beef, fish, cheese. Available heart-shaped, kibbled, or meal in 25-, 50-, and 100-lb. bags, 11-oz. cartons, 28-oz. Cellophane bags.

*DAILY RATION FOR A SMALL DOG (20 to 30 lbs.): Mix 2 cups Red Heart Kibbled with ¼ can Red Heart Canned Dog Food. Add 1 cup water or milk, and stir.

DAILY RATION FOR A LARGE DOG (50 to 60 lbs.): Mix 4 cups Red Heart Kibbled with 1 can Red Heart Canned Dog Food. Add 2 cups water or milk, and stir.
per pound of feed. These amounts may be obtained through the use of 30 per cent or more of a good quality yellow corn plus at least 5 per cent of a good grade of alfalfa meal. In addition, some of the other feedstuffs used, particularly fish liver oils, supply this vitamin in considerable amounts.

Vitamin D

The next in the group of vitamins that is necessary is vitamin D. This vitamin is necessary for the prevention of rickets in both young and laying stock. It is necessary for egg production, and for the production of hatchable eggs. In the absence of vitamin D, a laying hen will produce a few thin shelled eggs, perhaps a few soft shelled eggs and then the bird will go out of production. It is necessary to include this vitamin if there is to be a normal calcium and phosphorus metabolism in the fowl. The symptoms of rickets are: ruffled condition of the plumage in chicks, a crooked breastbone, a typical stilted gait, a reluctance to move about, and finally paralysis or inability to move about. The most economical source of this vitamin is direct sunlight, but it is supplied during the winter months through fish liver oils or feeding oils, through some of the new irradiated cholesterol products, or through irradiation with ultra-violet light. The standard fish liver oils have a potency of not less than 85 A.O.A.C.* units of vitamin D per gram and 600 International units of vitamin A. Thus, the fish liver oils are good sources of not only vitamin D but also of vitamin A.

More recently, since the imports of fish liver oils from foreign countries have been curtailed, animal feeding oils have been used which carry the same unitage as the standard fish liver oils. The irradiated cholesterol products are quite efficient for the chicken, but a distinction should be made between irradiated cholesterol and irradiated ergosterol. Irradiated ergosterol is not efficient for the chicken. The buyer will be protected in his purchases if the potency of products is guaranteed on an A.O.A.C. basis, which is a chick unit basis. There have been recent developments in the production of ultra violet bulbs which make it possible, from a practical cost standpoint, to use ultra violet irradiation in laying houses. When ultra violet lights are used as a source of vitamin D, the instructions of the manufacturer should be followed as to distance of the bulb from the flock and also as to time of exposure. Obviously, when the irradiated cholesterol and other similar products are used or when the ultra violet light is used, no vitamin A is included with the supplement. Therefore the yellow corn and alfalfa meal that are used in the mash must be inspected even more rigorously to make sure that only high quality products are used in order to help avoid a deficiency in the vitamin A content of the diet.

The chick requires a minimum of 175 A.O.A.C. units of vitamin D per pound of feed and the laying hen requires double that amount. It is quite frequently recommended that breeders be given a minimum of 500 A.O.A.C. units of vitamin D per pound of feed. This amount is supplied by the use of one-half of one per cent of the 85 unit oil for the chicks, one per cent for the layer, and one and one-half per cent of the same type of product for the breeder, or the equivalent in more concentrated products.

Vitamin B2

The other vitamin which is of practical importance in compounding poultry rations is riboflavin which is also known as vitamin B2 or G. This vitamin is necessary for normal growth and for the prevention of curled toe paralysis in chicks; it is necessary for egg production in the laying hen, and it is necessary for hatchability. When riboflavin is lacking in the diet of laying hens, hatchability drops very rapidly. The increase in hatchability when the vitamin is added is also quite rapid. The requirement of riboflavin for egg production is approximately 1600 micrograms per pound of feed, and for the breeder it is approximately 1200 to 1400. The requirements for egg production are lower than those for either growth or hatchability. These amounts will ordinarily be

* Association of Official Agricultural Chemists. This unit of vitamin D is determined especially for the chick and is based on the International rat unit.
supplied by the addition of 5 per cent of
dried milk and 5 per cent of a good quality
alfalfa meal or the equivalent of these
two. Since milk is not available to many
feeders and its price is almost prohibitive
at the present time, the following sugges-
tions are made as possible substitutions
for the dried milk to provide the necessary
vitamins and protein. That is, for 100
pounds of dried skimmilk it has been sug-
gested by the U.S.D.A., Bureau of Animal
Industry, Animal Nutrition Division in
A.N.D.* No. 5 that 10 pounds of dehy-
drated alfalfa leaf meal, 50 pounds of dried
whey and 40 pounds of fish meal (prefer-
ably sardine) might be substituted. An-
other possible suggestion is 10 pounds of
dehydrated alfalfa leaf meal, 40 pounds of
dried whey and 50 pounds of meat scrap.
While still another suggestion is 69 pounds
of Dried Corn Distillers solubles, 26
pounds of meat scrap and 5 pounds of pean-
ut meal. Many other substitutions are
suggested in A.N.D. No. 5 together with

* Animal Nutrition Division.

the protein and vitamin content of each
mixture.

Several other vitamins are necessary
for hatchability but these are supplied in
most practical rations. Among these are
vitamin E which apparently is necessary
for hatchability but which is supplied in
sufficient amounts in rations carrying the
ground whole grains in the usual propor-
tion. Choline is one of the newer vitamins,
and the best practical source of this vita-
min appears to be soybean oilmeal.

Minerals

Some of the mineral elements are also
important in egg production and in hatch-
ability. Chief among these are calcium,
phosphorus and manganese. Calcium and
phosphorus are, of course, necessary for
the prevention of rickets and the normal
formation of bone as well as being normal
constituents of other tissues. In addition,
they are also necessary for egg shell for-
mation and for normal embryonic develop-
ment. While it has been recognized for

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some time that vitamin D is necessary to regulate calcium and phosphorus metabolism, it has been found in recent years that manganese is also concerned in this process. The laying hen requires approximately 2.25 per cent of calcium and a minimum of 0.9 per cent of phosphorus in the laying ration; and, in addition, 50 parts per million of manganese are required for normal egg shell formation and for hatchability. When the diet is deficient in manganese, poor egg shell texture results and many of the embryos are deformed. This deformity is manifested as chondrodystrophy and in a wiry down condition. The amount of manganese required for either egg production or hatchability is usually supplied by the addition of 4 ounces of manganese sulphate per ton of total feed consumed.

The other minerals that are usually required are sodium and chlorine which are provided in common salt. Iodine is apparently necessary for normal hatchability, and in some cases it may be deficient. It may be supplied through the use of iodized salt or potassium iodide.

This is a very brief statement of some of the essential nutrient requirements for egg production and high hatchability. In times of high feed prices and in times of high egg prices these factors are of even greater importance to the poultrymen, and at present there is the added incentive of conserving food supplies for the defense program.

FETAL ABSORPTION
(Continued from page 78)

attachment of the fetal membranes. The blood supply to A, B, C and D appeared normal.

Discussion

From the history, it would appear that there was a deficiency of estrogenic substances. There was possibly a shortage of the estrogenic principle having to do with the full development of sex desire. There is another possibility that had the bitch been artificially inseminated following one of the atypical estrual period, conception could have taken place. Ovulation may have been normal as evidenced by the fact that at least four ova ruptured during the last estrum as revealed by the post mortem findings.

There is the possibility, too, that the dermatitis of both gestation periods was due to a deficiency of estrogenic substances. Sexual maturity in the human often puts an end to an adolescent dermatitis. A hypothyroidism could also cause a dermatitis and an edema of the feti. There was no evidence that a long standing hypothyroidism existed in this case because the thyroid was normal in size and weight. However, the low epithelium of the follicles and the abundant colloid might indicate a recent hypothyroidism.

The direct cause for the absorption of the feti is not known. Possibly the decreased number of basophiles in the anterior hypophysis could account for a diminished supply of luteinizer to the corpora and as a result the corpora were unable to maintain their normal function. Consequently, the feti were absorbed.

Whatever the cause of the absorption of the feti, the most logical conclusion is that the bitch was absorbing a histamine-like substance from the destruction of the feti and their membranes in the uterus. This caused a capillary dilatation over the entire body. This capillary dilatation in the skin resulted in the pruritis and eczema. It also caused the photophobia, the conjunctivitis, the acute pulmonary hypere mia and edema, the generalized serous lymphadenitis and the hyperemia of all parenchymatous organs. No infectious process was long standing enough to cause a rise in temperature or increased heart rate. It is probable that the pruritis, eczema and anorexia of the first gestation period was due to a similar condition because only one fetus reached maturity. There was no other apparent cause for an eczema and the history of the animal indicated the possibility of fetal absorption during the first gestation as well as during the second.

Death was due to the severe congestion of the lungs brought on by absorption of a histamine-like substance from a gravid uterus.

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