MINNESOTA FEED SERVICE

University of Minnesota Agricultural Extension Service, St. Paul — Fall 1962

PROTEIN-ENERGY RELATIONSHIPS FOR SWINE

R. J. MEADE

Adding fat to animal diets to increase the energy content has been investigated periodically and practiced to some extent for at least a quarter of a century.

Two developments since World War II increased our interest in fat-fortified rations for swine. One is the relatively low cost of fats per unit of energy. The other is successful development of antioxidants, so that rations containing added fat can be stored at room temperature without becoming rancid.

Feed processors and nutritionists have raised several questions regarding use of fats in rations of growing swine:

- If pigs eat to satisfy energy requirements and not within anatomical limits, must the protein content of the ration be increased?
- Will feeding fats, particularly those high in unsaturated fatty aicds, result in lower carcass quality?
- Will swine fed high energy rations simply become overfat and yield undesirable carcasses?
- If the proper amount and ratio of essential amino acids are maintained at all stages of the growing period, will swine fed high energy diets simply develop more rapidly without becoming overfat?

Based on a review of research conducted to date, these are the apparent answers:

1. Adding fat such as lard or stabilized animal tallow to rations adequate in protein and essential amino acids does not consistently result in more rapid and efficient gains.

2. Adding fat to rations that contain inadequate protein or an improper balance of amino acids, results in depressed gains and increased backfat thickness and trimmable fat.

3. When rations containing 4 to 12 percent fat are adequate in total protein and contain the proper proportion of essential amino acids:

- Daily feed intake is decreased.
- Daily gain is increased or is not affected.
- Less dry matter is required per unit of gain.
- Digestible energy required per unit of gain is decreased or not affected.
- Differences in loin eye area and percentage ham or lean cuts of carcass or slaughter weight will be small.
- Backfat thickness often increases with increasing levels of fat, but will not be accompanied by harmful changes in loin eye area or yield of trimmed lean cuts.

4. Total supply and proportion of essential amino acids are more important considerations than is the percentage of protein in the diet. When rations of 38- to 45-pound pigs contained adequate amino acids in the proper proportion, pigs gained rapidly and efficiently on a 10-to-13 percent protein ration. But when the ratio of amino acids was ignored, gains were depressed and hogs were fatter at slaughter weight.

5. Use of fats in swine rations appears to be a questionable practice, particularly in rations not properly balanced with amino acids. In such cases increases in rate or efficiency of gains, if obtained, are likely to be offset by harmful effects on carcass characteristics.

Adding small amounts of fats may be justified from the standpoint of improving pelleting characteristics and in reducing wear on milling machinery.

R. J. Meade is a professor in the Department of Animal Husbandry.

Calcium and Phosphorus for Swine Rations

Here are latest calcium (Ca) and phosphorus (P) recommendations for swine rations as given at the recent Minnesota Nutrition Conference for Feed Manufacturers and Dealers. They come from L. E. Hanson, head of the University of Minnesota's Department of Animal Husbandry.

Hanson emphasized that compositon of the rations affects Ca and P levels which the ration should contain. Recommended levels are based on the assumption that only limited amounts of milk and other animal products will be included in pig starters and that 50 percent or more of the supplemental protein fed to older animals will be supplied by soybean meal.

- **Rations for 10- to 40-pound pigs** should contain 0.8 percent Ca and 0.6 percent P.
- **For 40- to 100-pound pigs,** for growing boars and gilts, and for yearling sows and gilts during gestation and lactation, recommended amounts are 0.7 percent Ca and 0.5 percent P.
- **Rations for mature sows** require 0.6 percent Ca and 0.4 percent P.
- **Recommended levels for mature boars and for market pigs** over 100 pounds are 0.5 percent Ca and 0.4 percent P.

In areas where rations contain more animal byproducts high in Ca and P than usual in the Corn Belt, somewhat lower levels may be fed with satisfactory results.

Nutrition and Management For SPF Pigs

A. H. JENSEN

Specific Pathogen-Free (SPF) swine are taken aseptically by hysterectomy on or about the 112th day of gestation. They are raised in isolation units for 4 weeks, then placed on premises not previously populated with swine or cleared of non-SPF swine and cleaned.

To continue to qualify as SPF, a herd must be certified free of atrophic rhinitis, virus pig pneumonia, brucellosis, and dysentery. SPF replaces the term "disease-free" earlier used to describe animals known to be free of certain diseases but not "germ-free."

SPF swine are classified as: **Primary** —those pigs removed from the dam by hysterectomy, and **Secondary** — the normally-farrowed offspring from primary stock and succeeding generations.

Primary SPF pigs are extremely susceptible to infection. They have not nursed the dam and are deprived of the antibody protection normally provided through the sow's colostrum. So, they are confined in isolation units for the first 4 weeks to allow pigs time to develop some of their own disease-combating mechanisms. Normally farrowed pigs do not develop antibody-producing ability until at least 3 weeks of age.

Secondary SPF pigs, however, have the benefits from normal birth and nursing.

In February 1960, at the University of Illinois, our first of 21 litters from selected sows and gilts was taken by hysterectomy. These litters were seed stock for a herd now used for research in breeding and genetics. They were confined to isolation units for the first 4 weeks, then moved to a farm that had no recent history of swine population. Additional litters were secured for investigations in management and nutrition.

Experiments with Primary SPF Pigs

Performance of the hysterectomy-derived pig is markedly affected by management and feeding programs. From birth to 21 days of age pigs fed seven times a day gained significantly faster than littermates fed three times daily. This performance increase reflected the greater total nutrient intake per day. Feeding smaller amounts at more frequent intervals essentially eliminated "overfeeding diarrhea" which occurred often when large quantities were fed infrequently. These results are not surprising since the newborn pig nurses frequently and for short periods of time.

Antibiotic in the diet to provide 100 milligrams per pig per day had no harmful effect and appeared to have a protective effect against nonpathogenic organisms encountered in the brooders.

A lactose-casein diet, previously shown adequate for pigs weaned at 2 and 3 days of age, was inadequate for the SPF pigs.

Experiments with Secondary SPF Swine

Other things being equal, the secondary SPF pig should be healthier than his non-SPF counterpart. He would thus be expected to more fully realize his genetic growth potential. This raises the question, "Do SPF and non-SPF pigs differ in their nutritive requirements?"

We could argue that the SPF pig needs more of certain nutrients per pound of feed or per pound of body weight because of his rapid growth. Or, we could argue that the SPF pig, being healthier, should utilize ration nutrients more efficiently. That's because fewer disease organisms would compete for or inhibit nutrient utilization.

What About Antibiotics?

The SPF program is a means of eliminating some diseases against which antibiotics and drugs have been ineffective. However, an SPF pig encounters various bacteria and other organisms regardless of how clean the premises were when he entered. Should any of them be harmful to the pig but also susceptible to antibiotics, antibiotics in the feed would be beneficial.

Feeding Trials

In comparative feeding trials involving secondary SPF swine, fortified corn-soybean meal rations were fed. All animals had been confined since birth.

Feeding more vitamin supplement than needed to supply recommended levels of pantothenic acid and niacin proved of no effect. In other tests, vitamin B_{12} additions above the recommended level had no effect on growth rates and feed efficiency.

Growth rate was depressed with a 1.1 percent calcium level. There was no gross evidence of calcium deficiency in pigs receiving a 0.34 percent calcium ration.

Protein level had no significant effect on growth rate and feed efficiency of growing-finishing secondary SPF swine. However, adding antibiotic significantly increased growth rate. Other antibiotic comparisons gave variable results, but average growth rate was higher for the antibiotic-fed pigs than for pigs fed the control ration.

Problems and Performance

Based on experiences at the University of Illinois, in commercial laboratories and on farms, these are the most common experiences in problems and performance:

Primary Swine Problems

Laboratory problems:

- Death losses due to bacterial contaminants which are considered "normal" in non-SPF swine populations.
- Environment control. Temperature is very critical during the first 48 hours.
- Development of partial or complete blindness in individual animals.
- Attempt of pigs to nurse each other when placed in community brooders.

Farm problems:

- Variations in growth rate and age at sexual maturity.
- Stiffness and sore feet.
- Susceptibility to bacterial infections.
- Contamination from internal parasites when placed on pasture or ground where hogs were formerly raised.
- Nonworking or ineffective boars. This occurs frequently when a primary boar is introduced to a non-SPF herd.
- Low conception rate in gilts.

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Primary Swine Performance

Laboratory performance:

- Small and unthrifty pigs at 4 weeks of age.
- Lack of uniformity.

Farm performance:

- General performance classified as average, with considerable variation. Extremely poor or good performance possibly reflects management and environment.
- Dramatic response of "sick" pigs to antibiotic therapy.
- Variable litter size at farrowing.

Secondary Swine Problems

- Secondary swine problems are primarily associated with management. They include bacterial scours, outbreaks of TGE, overcrowding, and insufficient water and feed.

Secondary Swine Performance

- Secondary swine show marked improvement over primary stock on the average. They are free from the sensitivity and high susceptibility to environment shown by primary stock. And antibiotics in well-balanced grower rations have stimulated growth.

The SPF swine program has become an important part of the swine industry, although time has not yet fully allowed final evaluation.

Primary SPF pigs have been highly variable in performance and in their ability to withstand the nonsterile farm environment. Secondary SPF pigs have been free of many of these difficulties.

Limited research indicates that nutritive requirements of secondary SPF swine are not significantly different from non-SPF swine. In general, the feeding program that does a good job for regular herds should do an excellent job for SPF herds.

SPF pigs are usually less responsive than others to antibiotics. Response to antibiotics in the feed reflects the extent of contamination by various organisms.

The degree of success realized with the SPF program under the many and varied circumstances now being tried will determine its role in future swine production. Its potential is only as great as the intelligence and know-how swine producers exercise in its application.

HIGH ENERGY RATIONS FOR BEEF CATTLE

O. E. KOLARI

Feeding high amounts of ground shelled corn with a minimum amount of hay to cattle is not a new practice. Feeders in Corn Belt states for years have successfully fed minimum amounts of hay during the terminal phases of feeding. Also, it has been a common feedlot observation that cattle fed extremely high-energy, or "hot," rations during a long feeding period often were subject to going off feed, stiffness, founder, scours, and other feedlot problems.

High-energy rations for beef cattle are usually fortified with 1 or 2 pounds of a supplement. These supplements may contain soybean meal (about 5 percent fiber), linseed oil meal (8-9 percent fiber), cottonseed meal (10-11 percent fiber), dehydrated alfalfa meal (19-28 percent fiber), in addition to such feedstuffs as molasses, beet pulp, minerals, salt, vitamins, and various feed additives. Thus, the supplement may contribute appreciable amounts of fiber —or roughage—to the ration.

High-energy rations based on ground shelled corn, urea, a protein supplement, minerals, feed additives, and vitamins may contain as little as 2.3 percent fiber. By comparison, a standard feedlot ration made up of about 18 pounds of ground ear corn, 3 pounds of hay, and 1 pound of protein supplement may contain 10.5 percent fiber. The precise minimum amount of fiber necessary to provide the roughage factor in cattle rations is not known. But it appears to be below the 6 percent fiber content of barley.

Current information on high-energy rations warrants the following conclusions:

When feeding all-concentrate rations, good feedlot management and these precautions are important:

1. The change to all-concentrate rations should be gradual.
2. Feed should be constantly available to prevent cattle from consuming large amounts at one time.
3. Rations should contain adequate minerals and vitamins.

- Average daily gains of cattle fed all-concentrate rations are not necessarily greater than cattle fed nominal amounts of roughage. However, efficiency of feed use favors high-energy rations.
- The place of buffers or alkalizing agents used to control rumen acidity in cattle feeding, needs further research. Results to date have indicated little benefit from such ration treatment.
- Although research results have been variable, it appears reasonable that cattle fed properly supplemented all-barley or all-ground ear corn rations will have similar weight gains. However, cattle fed ear corn rations have consistently required more feed per unit weight gain.
- Feeding low levels of hay with barley rations does not necessarily reduce weight gains of cattle. But efficiency of feed use favors the all-barley ration.
- Cattle fed high-energy rations have not produced superior carcasses compared to cattle fed rations containing nominal amounts of roughage.
- Rumen pH (the level of alkalinity or acidity) and volatile fatty acid production are affected by ration treatments.
- Rumen parakeratosis (thickening of the horny tissue portion of the rumen lining) and other rumen problems, have been observed in cattle fed high-energy rations.
- Feeding high-energy or all-concentrate rations eases automation of feeding operations.
- Steam-rolled has not been superior to dry-rolled barley. High-moisture ensiled barley is equal to dry-rolled barley (on a moisture equivalent basis) for beef cattle.
- Pelleting all-concentrate rations does not improve feedlot gains, although efficiency of feed use has often favored the pelleted feed.

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Articles in this issue are condensed from papers presented at the recent Minnesota Nutrition Conference for Feed Manufacturers and Dealers. The Conference met September 10 and 11 on the University of Minnesota's St. Paul Campus.

Feeding Grain For Milk Production

DONALD HILLMAN

Rarely does a dairyman deliberately underfeed his cows. It usually happens unwittingly through reasons he doesn't recognize. Cattle voluntarily underfeed themselves when hay quality is not up to par or when they must depend on high-moisture grass silage as a major source of nutrients. Few dairymen adjust grain feeding level when forage quality changes. But forage quality research indicates that 10 to 12 pounds of extra grain may be required to compensate for variations in consumption and digestibility when different forage lots are fed.

Why Cows Are Underfed

Milking parlors limit grain feeding according to the time the cow is in the parlor. Most parlors are designed for rapid and efficient milking but do not allow time for high-producing cows to eat sufficient grain (concentrates).

Research indicates that an average cow can eat about 0.6 pounds of grain per minute in milking parlors; somewhat less in a stanchion barn.

In practice, a cow's daily concentrate intake is limited to approximately the amounts indicated in table 1.

Better cows in the herd are most frequently underfed, and herds are constantly being upgraded by culling and improved breeding stock. Production potential of the average dairy cow is now considerably better than it was 10 or 20 years ago. Today's better bred cattle require more feed to reach full production potential and maintain higher milk production levels than most dairymen are accustomed to feeding.

When feeding level is limited, high-producing cows lose much body weight. They then decline rapidly within 6 to 8 weeks to a lower production level that can be maintained by the level of feeding. Grain feeding is most essential during this early lactation period.

Fear of causing udder congestion, mastitis, sterility, or of "burning up" the cow causes some dairymen to limit grain feeding. Interestingly, these opinions are not supported by research and are most apparent among dairymen who have not fed heavily.

Grain prices are favorable for heavier grain feeding where grain is plentiful. The cost of 100 pounds of nutrients (TDN) from grain is frequently as cheap as hay in the better grain-producing areas and may be nearly as cheap in grain-deficient areas.

Recognizing that feeding problems do exist on farms is the first step toward accepting the concept of heavier concentrate feeding. Few dairymen follow established feeding standards, but these standards have only limited practical value. The move toward heavier concentrate feeding is an attempt to feed dairy cattle adequately to obtain production levels made possible by improved breeding.

Feeding and Feed Costs

Examination of Michigan Dairy Herd Improvement Association summaries for several recent years reveals a close relationship between production level, amount of concentrates fed, and return above feed cost (table 2).

These data suggest that the amount of grain fed was an important factor in arriving at a given production level. However, the table also suggests that "true" potential production of lower-producing herds is not known, because these herds were not fed as heavily as high-producing herds. The only way to determine potential production of a cow (or herd) is to challenge by heavy feeding and measure response in milk production.

Table 1. Feed consumption in milking parlors

Parlor type	Eating time in minutes for milking	Grain per day (average cow)
		pounds
Double 5 herringbone	14	16
Double 3 walk-through	10	11
3 U side-opening	7	8
3-in-line side-opening	8	9

Rule of Thumb Not Satisfactory

Thumb rules that feed according to production are unsatisfactory for establishing potential production. The level of feeding lags behind production. It depends upon production rather than leads production, as in challenge feeding.

Thus, in a modern feeding program, cattle should be fed for production. Feeding level then sets the pace for future production. Once the potential rate of production is established, grain feeding can be gradually adjusted according to production to conform to economic considerations.

A positive program consists of:

(1) Using the best breeding available. This is usually obtained through artificial insemination.

(2) Keeping and using dairy herd improvement records.

(3) Feeding concentrates liberally before calving and early in lactation.

(4) Culling cows that produce 70 pounds of butterfat or 2,000 pounds of 3.5 percent milk below herd average on a 305-day mature equivalent basis.

This program can move the average production of any dairyman above the 500 pounds of butterfat class in 3 to 5 years if he does a reasonable job with other management. In view of the current milk-surplus situation, any program designed to increase production per cow must necessarily emphasize culling less profitable cows.

(Continued on page 5)

Table 2. Annual summary of Michigan Holstein DHIA-IBM herds, 1961 (based on average milk production)

Production grouping (pounds milk)	Averages per cow: Pounds milk	Pounds butterfat	Pounds grain	Feed cost (dollars)	Returns over feed cost (dollars)	Feed cost per 100 pounds milk (dollars)
16,000-over	16,630	598	4,850	213	495	1.28
14,000-14,999	14,424	523	4,510	201	424	1.39
12,000-12,999	12,462	452	3,740	182	353	1.46
10,000-10,999	10,544	384	3,410	171	279	1.62
8,000- 8,999	8,589	316	2,950	160	207	1.86
8,000-under	7,272	270	2,200	143	160	1.97
All	11,635	423	3,610	177	322	1.52

Donald Hillman is dairy extension specialist at Michigan State University.

MICROBES AND FEED QUALITY

C. M. CHRISTENSEN

Microbes are myriad in grains and feeds. More than 160 species or kinds of molds and a large number of species of yeasts and bacteria have been found on barley grain. Other grains probably bear an equally large assortment of microbes. It is common to obtain thousands to tens of thousands of mold colonies from 1 gram (about 25 kernels) or 1/450 of a pound of malting barley, plus tens to hundreds of thousands of yeast colonies, and hundreds of thousands to millions of bacteria colonies. Most feed grains bear more microbes than malting barley or grain intended for human food.

Grain molds can generally be divided into two groups:

Field molds invade kernels while they are developing on plants in the field. Field molds cease to grow on threshed grains or in feeds whose moisture content is below 20 percent, but may grow on moist corn stored on the cob in cribs. They may survive for months or years in dry grains.

Storage molds do not infect the grains significantly before harvest, but may invade grains and feeds stored at moisture contents above 13 percent. The extent to which storage molds invade stored grains and feeds is determined by moisture content and temperature of the stored materials, length of storage, amount of mold present at the beginning of storage, and activities of grain-infesting insects and mites. If storage molds grow rapidly enough, they cause grains and feeds to heat. But heating is not a good criterion for presence of mold in grain and feed.

Heating generally indicates final—not beginning—stages of spoilage by molds.

Some of the most common storage molds grow too slowly to cause detectable heating, but still cause extensive spoilage. Although several compounds have recently been advertised as effective mold controls for feed grains and feeds, none tested by us has been of real value in controlling molds in grain stored under field conditions.

Moldy Grains and Feeds

Barley invaded by certain species or strains of *Fusarum* (a common field mold that produces scab or blight in barley, wheat, and corn), is known to be toxic to swine. Other common field molds are suspected of being toxic when present in sufficient amount, or when they have developed under special conditions.

In Georgia in 1952 and 1953, moldy corn was held to be the cause of the death of hundreds of swine. Samples of this corn given to hogs by stomach tube poisoned the animals. Two molds cultured from the corn were grown on autoclaved corn, and either the mold-corn mixture or a water extract of it administered to experimental animals was toxic. Eight to 16 ounces of corn on which *Penicillium rubrum*, the most toxic of the two molds, was grown was given via stomach tube to pigs weighing 30 to 60 pounds. It killed them in 18 to 36 hours. Nine isolates of *Aspergillus flavus* from the moldy field corn were similarly tested; only one proved toxic.

Aspergillus flavus is a common storage mold on grains stored at moisture contents above 17 percent. *A. chevalieri* is common on grains and feeds kept at a moisture content of 15 to 18 percent. Each of these was inoculated separately on to ground wheat and allowed to grow for 15 days.

The moldy wheat was then mixed with complete feed in the ratio of about 1:14, and fed free choice to 10-day-old chicks. The chicks developed extensive internal hemorrhages and diarrhea.

Wisconsin calves which had eaten a pelleted feed developed hyperkeratosis, an overgrowth of the horny layer of the skin. *Aspergillus clavatus*, another storage mold, was isolated from the pelleted feed, grown on sterile whole corn, and fed to three calves. Two calves died in 5 to 13 days, the third developed extensive hyperkeratosis.

Recently, several samples of toxic peanut meal have been encountered in Africa, Brazil, and India. The toxin was a product of *Aspergillus flavus*.

It seems unquestionable that certain common molds growing in grains and feeds under certain conditions produce materials toxic to animals. Exact conditions that cause production of toxins by micro-organisms or combinations of micro-organisms are not yet known. The problem appears complex, and much more research is required to provide the answers.

C. M. Christensen is a professor in the Department of Plant Pathology.

Feeding Grain —

(Continued from page 4)

Feeding programs on most dairy farms cannot achieve the potential economical production for which the cattle were bred. Therefore, more liberal use of concentrates can substantially increase milk production per cow and improve overall dairy farm efficiency.

The potential production of a cow can best be established by offering liberal amounts of concentrates (1 to 2 pounds per 100 pounds of body weight), starting about 3 weeks before calving. Concentrates are then increased after calving until either peak production or peak appetite is reached. If, after about 60 days after calving, the level of feeding appears uneconomical for the level of production, adjustments can be made.

Where cattle are fed concentrates in milking parlors it is generally necessary to feed additional grain in feedlot bunks. In such cases, best use is made of concentrates if cattle are handled as two or more groups. A suggested method is to feed additional concentrate to: (1) dry cows for about 3 weeks before due date; (2) all fresh cows for a period of 90 to 120 days after calving or until they drop below 50 pounds of 3.5 percent milk per day. All other cows get only the concentrates allowed in the milking parlor.

Feeding concentrates more liberally resulted in substantial gains in milk production in many Michigan dairy herds. This liberal feeding is rapidly becoming a standard practice among dairymen.

See materials-handling displays from 9:30 a.m. to 6:30 p.m. each day during Corn-Soybean Day October 10 and Beef Feeders Day October 11 at the University of Minnesota's West Central School and Experiment Station, Morris.

MINNESOTA FEED SERVICE

Published by the University of Minnesota Agricultural Extension Service, Institute of Agriculture, St. Paul 1, Minnesota.

Feed Service Committee—Harold B. Swanson, chairman; William Hueg; William Flemming; Lester Hanson; Hal Routhe; Curtis Overdahl; and Robert Berg. Harlan Stoehr, editorial assistant for the committee.

Feeding Replacement Pullets

D. C. SNETSINGER

Nowhere in the poultry industry is there less consistency than in management and feeding programs for replacement pullets.

Programs vary from 6 to 24 hours of light at 8 weeks of age, from range to complete confinement, and from full feeding of high energy ration to restricted feeding of low energy ration. That all have had some success indicates that the pullet can adjust to a wide variety of rations and management conditions.

The first goal of any replacement pullet program is to produce a bird that matures sexually at a desired time and, once in production, lays at her maximum rate for the year.

A second major goal often requires compromise with the first and contributes to the wide variety of current feeding programs. This is to produce the pullet with least cost.

Three Feeding Systems

In general, pullet feeding can be broken down into three major categories:

1. Full feeding of a well balanced, low-to-medium fiber ration.
2. Limited feeding (by controlling feed available to birds) of a well balanced, low-to-medium fiber ration.
3. Full feeding of a ration deficient in one or more nutrients—usually energy or protein.

Range rearing versus confinement can be an additional variable for each category.

Low-Medium Fiber Ration

Full feeding a well balanced, low-to-medium fiber ration is still popular. This program keeps birds in good condition, both in appearance and flesh. Pullets have greater nutrient reserves at start of production, an advantage in case of disease outbreak during the growing period. This program gives more assurance that birds consume enough of all nutrients.

The main disadvantage of this program is that it is often uneconomical. Also, with high energy levels it leads to more rapid sexual maturity than desired.

Skip-a-Day Feeding

A method of restricted feed intake recently attempted at the University of Minnesota is the skip-a-day program. This program was used successfully by E. P. Singsen, University of Connecticut, for broiler hens in production. In our study, sexual maturity of broiler-type replacement pullets was investigated using the following treatments:

- Full fed a standard corn-oats-soybean meal type grower ration of medium energy level.
- Fed the same ration for 6 days but given nothing the 7th.
- Fed the same ration for 3 days, then given nothing on the 4th.

There was: (1) no difference in body weight at the end of the experiment, (2) slightly less feed consumed by the skip-a-day lots, and (3) delayed sexual maturity for birds not full fed. Mortality did not differ between lots.

However, pullets in the skip-a-day in four group were definitely more variable and some were in very poor condition. This variation was not a problem in the skip-a-day in seven group.

Limited Feeding

Limiting feed intake, by giving only 75 to 80 percent of normal consumption, has been accepted by some commercial growers of started pullets. Feed costs then can be standardized and possibly reduced. Research indicates that this program markedly delays sexual maturity, increases egg size, and generally decreases henhouse mortality.

A principal disadvantage of this program is that birds are not always occupied when feed is unavailable. This sometimes leads to cannibalism and to wide variations in body weight. Since there is greater competition for feed, weaker birds are forced to get by with less. Also, labor costs are greater.

High Fiber Rations

To overcome some disadvantages of limited feeding, programs were developed to allow birds to eat all feed they desire. But effective nutrient intake is limited by diluting the ration with fiber. Because birds have a limited capacity to consume large quantities of fiber, they are limited in the effective nutrients they can consume.

Many claims have been made for high fiber rations. Main advantages appear to be delayed sexual maturity, larger eggs, and decreased feed costs. Observations vary on increased laying house livability and egg production.

Disadvantage of restricted feeding programs which reduce effective energy intake is that birds consume large quantities of high fiber feed.

We also studied use of restricted protein intake to delay sexual maturity but found small differences over the wide variety of protein levels fed.

Summary

It is difficult to speak of specific nutritional requirements for replacement pullets. A given nutrient level may be satisfactory in one program but not in another. The saving factor for many programs currently used is that they include large excesses of most nutrients, especially protein, most vitamins, and most supplemental mineral elements such as calcium, phosphorous, and sodium.

We still need many basic studies to determine minimal nutrient requirements before nutritionally balanced feeding programs can be developed.

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UNIVERSITY OF MINNESOTA, INSTITUTE OF AGRICULTURE, ST. PAUL 1, MINN.

Cooperative Extension Work in Agriculture and Home Economics, University of Minnesota, Agricultural Extension Service and United States Department of Agriculture cooperating, Skuli Rutford, Director. Published in furtherance of Agricultural Extension Acts of May 8 and June 30, 1914.

AGRICULTURAL EXTENSION SERVICE
Institute of Agriculture
University of Minnesota
St. Paul 1, Minnesota
SKULI RUTFORD, Director
Cooperative Agricultural Extension Work, Acts of May 8 and June 30, 1914.
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