MINNESOTA FEED SERVICE

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Appraisal of Antibiotics in Poultry Feeding

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MOST of our feeds for young growing stock contain one or more antibiotics at the present time. The growth promoting activity of antibiotics is well established and the feeding of antibiotics during certain portions of the life of the chicken or turkey means additional dollars to the poultryman.

The many reports concerning antibiotics in poultry nutrition make it difficult to keep abreast of the present status of this important phase of our feeding recommendations. The following represents the status of antibiotics in today's feeds, and some of the possibilities regarding their actual role in stimulating growth. The anticipated future in relation to antibiotic feeding will also be discussed.

When Can Antibiotic Responses Be Expected?

The major beneficial effect of feeding antibiotics appears to be in the increased growth stimulation and efficiency of feed conversion with young chickens and turkeys. Growth increases may range from zero to as high as 20 per cent additional body weight during the early weeks of life.

Most responses, as the result of antibiotic feeding, fall in the range of a 5 to 10 per cent increase in growth during the first 8 to 10 weeks of life. It is generally agreed that as the chicken or turkey reaches maturity, the percentage increase due to antibiotic feeding will gradually be reduced until maximum body weight is obtained, regardless of whether an antibiotic is being fed. This situation clearly points to the recommended use of antibiotics for broiler production with either chickens or turkeys.

The use of antibiotics for feeding turkeys to maturity seems to be justified as it may enable the turkeys to reach slightly higher body weights at an earlier age, which might be of considerable advantage in the marketing of turkeys for the Thanksgiving or Christmas holiday seasons.

Experiments with adult birds in the laying house have not yielded any consistent or significant responses of the hens in terms of increased egg production or hatchability. It hardly seems justifiable at this date to recommend the inclusion of antibiotics in rations which are to be fed to layers or breeding hens.

The question of what happens to pullets which have been reared on antibiotic feeds has been answered in part by experimental studies. It has been shown that the feeding of antibiotics to chickens during the growing period does not have any effect on pullet mortality or sexual maturity. Mature body weight, laying house mortality, egg production, fertility, egg weight, or shell thickness are also unaffected by the antibiotic feeding during the growing stage.

Action of Antibiotics

We recognize that antibiotics are not required nutrients in the sense that we think of our vitamins. In the absence of critical vitamins our poultry will actually die because these nutrients are required for metabolism. Since we recognize the antibiotics merely as growth stimulants and not as essential metabolic compounds, then we are interested in the actual role the antibiotics play in increasing growth. Work with chicks in 1951 and 1952 at the University of Reading, England, the USDA Station at Beltsville, and at the University of Minnesota has indicated that environment appears to play an important part in obtaining responses with antibiotics. There is little doubt in my mind that this enviromental problem is primarily associated with a so-called "disease level" which represents the presence of undesirable microorganisms that can be controlled in part by antibiotic feeding. Some of the experimental reports have referred to such environmental differences as "new" or "old" environments, new being used to refer to equipment and houses which have not previously been occupied by poultry.

It seems apparent that the control of these organisms occurs chiefly in the intestinal tract and with this assumption we have additional possibilities regarding the role of any given antibiotic. One possibility is that certain microorganisms in the intestines produce toxins which are in turn harmful to the bird. A second possibility exists regarding the production of favorable organisms which conceivably produce unidentified factors required in appreciable quanities by the growing birds. Of course, we must consider that a combination of these actions may occur and that numerous other possibilities regarding the disease level theory may prove sound as our experimental studies on antibiotic action progress.

The reduced effect of antibiotics as the bird reaches maturity, and the apparent lack of any effect during the egg production season make it difficult to explain the action of antibiotics which are primarily confined to growth stimulation alone. The theory relating to unidentified factor requirements could be substantied by the possibility of the laying hen requiring relatively small quantities of such unidentified factors.

Many of our nutrients are required in decreasing amounts as birds approach maturity and produce eggs. The theory regarding control of undesirable organisms might be explained with the thought of the bird becoming more resistant to such organisms as age increases, and of course, eventually exhibiting no effect from the normal population of such organisms which occur under average conditions.

Germ-free studies at the University of Notre Dame have indicated little or

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Give Rumen Back to the Ruminant

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"LET'S give the rumen back to the ruminant" may sound like a completely unscientific statement. After all, isn't every cud-chewing animal equipped with a rumen? Then why do we have to give it back?

The answer lies in the treatment or management of the rumen. True, every cud-chewing animal posesses a potentially useful rumen, but in many cases through feeding or management practices the rumen functions inefficiently.

If this is true, is it serious? The answer in the light of recent research and recent economics is definitely yes. Cows, sheep, and other ruminants are of importance in our economy because they are able to live and thrive on a ration composed largely of inexpensive roughage that would be inadequate for the nutrition of nonruminant animals. Since the efficiently functioning rumen is the reason for this success, isn't it only common sense to make the best use of this wonderful organ and to get the most out of its peculiar capabilities?

Of course, the practical side of this interesting question is "how do we go about it?" First, research must offer an understanding of how the food is digested in the rumen and then this information must be put into practice in order to help the rumen to do an efficient job.

Although research is just beginning to scratch the surface, some understanding has been obtained about the rumen and rumen function. Let's consider briefly rumen structure and physiology, the role of rumen environment and microflora in the digestion of food, the end products formed from the digestion of food in the rumen, and the factors affecting the rumen flora and environment.

What Is the Rumen?

The rumen is a very large anaerobic organ which contains the food and water and into which is secreted quantities of saliva. In this first stomach the food is digested by large numbers of rumen bacteria, and the end products of this decomposition are used by the ruminant as food.

The rumen is an ideal fermentation vat and practically all the food that enters it is processed by the bacteria. About 25 different varieties of organisms have been isolated from the rumen and studied for their probable role in ruminant digestion, as well as their nutritional requirements.

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This article on the rumen is a condensation of a talk by Dr. L. S. Gall at the annual Animal Nutrition Short Course, September 14-15, at the University of Minnesota. Summaries of other important talks at the meeting will be made in the December issue of Minnesota Feed Service.

Some of the functions which these highly important bacteria perform in the rumen are fiber digestion, fermentation of available carbohydrates, synthesis of B vitamins, and the utilization of urea. Studies of the nutritional requirements of these helpful rumen organisms aid in determining what foodstuffs must be provided to the bacteria by the ration to insure an active rumen flora. The useful end products formed by the bacteria from digesting the ration are organic acids such as propionic, butyric, acetic, and lactic acids, and some B vitamins. These are absorbed or pass out of the rumen and are used by the animal for food. The bacterial cells themselves leave the rumen with the undigested food residues. These cells, which are used as a source of protein, are digested in the abomasum and lower digestive tract.

How Does the Ration Affect the Rumen?

Since a good rumen flora is necessary for the proper nutrition of the ruminant, it is essential to understand the factors affecting the rumen organisms. Ration itself is the most important single factor influencing rumen flora and environment.

If a ration is deficient in some nutrient, the rumen flora usually changes and the roughage may not be well digested. If too much readily available carbohydrate, such as grain or molasses, is fed, the lactic acid which piles up in the rumen depresses the digestion of roughage because the delicate roughage digesting organisms do not thrive in this environment.

When a ration is compounded, it is essential not only to have present the proper chemicals, but these nutrients must be available at the right time to the rumen organisms to insure efficient use. Urea is not too satisfactory as a supplement to a wholly roughage ration since the very soluble urea may have passed out of the rumen before the energy of the fiber is available.

The physical properties of the food as it enters the rumen are important also. If food is ground or divided too finely, it may pass out of the rumen too quickly to be properly digested by the rumen organisms. All of these factors must be considered when preparing a ruminant ration since it is apparent that in feeding a ruminant we are actually feeding the rumen flora, and adequate nutrients must be provided in a condition that is acceptable to these microorganisms.

It can easily be seen that the rumen flora and environment so essential to the ruminant can be changed by feeding and management practices. The properly functioning rumen is primarily suited to the processing of inexpensive roughage, which is of great economic importance. By feeding the wrong feeds or combination of feeds, we can change the rumen flora so that we interfere with the efficiency of normal rumen functions such as fiber digestion, B vitaman synthesis, or urea utilization.

For instance, heavy grain feeding creates a rumen flora and environment that cannot efficiently digest fiber; urea must be properly balanced with other nutrients and a deficient ration can lead to inefficient rumen digestion. Too finely divided roughage may pass out of the rumen undigested. All of these and other factors influence the ability of the rumen to function properly.

It is important not to fall into the common error of resorting to the kind of feeding practices that mask poor rumen function. For instance, it is preferable to use heavy grain feeding only after the rumen has demonstrated that it cannot process enough nutrients from good roughage to do the required job.

By taking into consideration and encouraging the primary function of the rumen, which is fiber digestion, the wonderful capabilities of the rumen to process inexpensive types of feed can be used to the fullest extent and a sounder ruminant industry will result.

This is just another way of saying—give the rumen back to the ruminants and let them show their appreciation in dollars and cents!

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no response to antibiotic feeding. These results would tend to support the theory of controlling harmful organisms by antibiotic feeding, since the germ-free chicks grew satisfactorily in environments which were not contaminated with the obvious bacterial population existing under practical conditions.

On the other hand, several reports are found in the literature to indicate the failure of antibiotics to stimulate growth of chicks receiving highly efficient diets under apparent contaminated environmental conditions. This could be explained on the basis that such a diet provided the unidentified factors which might be provided in part by organisms favored in antibiotic feeding, or it could mean that this type of a diet might act in some manner to control the organisms similar to the antibiotic control.

Species Affected by Antibiotics

Everyone recognizes that antibiotics will increase the growth of young chickens and turkeys, but there is some evidence regarding other species that are of interest.

Work at Cornell University has indicated that antibiotics caused a significant increase in the growth of pheasants, and that ducks showed a small gain in weight. In contrast to the report with ducks, the Ontario Agricultural College reported in 1953 that antibiotics had no effect on growth or feed efficiency of young ducks.

A report from Purdue University demonstrated that bobwhite quail chicks responded to aureomycin feeding when the protein was at a 20 per cent level but no response was obtained when the protein was increased to 28 per cent.

Goslings have also been reported to respond to antibiotic feeding, although this response is most marked during the first two weeks of life and the difference disappears soon thereafter. One report from the Ontario Agricultural College indicated that goslings did not respond to penicillin feeding when fresh lawn clippings were fed at all times.

These species differences in response to antibiotics is of considerable interest to the research worker and pose additional problems regarding the mode of action of antibiotics since it is extremely difficult to explain the species differences.

Other Considerations

Many nutrients and other growth stimulants have been evaluated along with antibiotic feeding. For example, surfactants have not given any consistent growth response in addition to the feeding of penicillin or aureomycin. Surfactants are surface active agents which include some of the detergents.

A similar situation appears to exist in regard to feeding arsenic compounds as the effect of arsenic and the antibiotics does not seem to be additive under most conditions. However, we must recognize a distinct difference here between the arsenic compounds and the so-called surfactants since the growth stimulating power of the arsenic compounds in the absence of antibiotics is well recognized.

A report from the Ohio Experiment Station showed that feather picking among broilers receiving 10 or 15 per cent cottonseed oil was considerably retarded when penicillin was included in the diet. Whether this will have a significant effect upon commercial broiler raising in the field is not indicated in this prelmininary report. It is obvious that such a development would be of considerable economic importance in the poultry industry.

The four antibiotics which are commonly employed in today's ration formulation are aureomycin, bacitracin, pencillin, and terramycin. Although one exact level for best results under all conditions is not established, the usual feeding levels are from one to two grams of penicillin and from 6 to 10 grams of any of the remaining three antibiotics in each ton of complete feed. Using a combination of antibiotics does not seem to have any advantage.

The efficiency of different forms of penicillin is promoting growth has been questioned and a recent report by the Tennessee Agricultural Experiment Station demonstrates that procaine and diamine penicillin possess similar growth promoting properties.

Future for Antibiotics

The inclusion of antibiotics in many feeds is a sound practice and can return additional profits to the poultryman. Although the exact role of antibiotics in stimualting growth is not known, it is apparent that antibiotics will continue to play an important role in future feeds.

Do Chemical Soil Conditioners Pay?

W. W. NELSON AND J. M. MacGREGOR*

"Will it pay to use a chemical soil conditioner on my soil?" This is a question that has been asked many times since the first soil conditioners were announced about a year and a half ago. The answer to this question on the many soil types can only be answered after a great deal of experimental work.

Soil conditioners themselves do not add plant nutrients and so are not fertilizers. Their one purpose is to maintain a desirable soil structure after it has been produced by some suitable method, such as tillage. Most soils when cultivated at a good moisture content naturally develop a desirable structure. This condition gradually disappears if it is not stabilized by some agent, such as organic matter, or by soil conditioners. The latter are most effective in heavy soils containing a fair supply of organic matter.

Soil conditioners do have distinct advantages. When 400 pounds were mixed into the top three inches of soil in the greenhouse the rate of water infiltration was greatly increased. The average time for 2 inches of water to infiltrate into the treated soil was 101 seconds, whereas, 438 seconds were required for the untreated soil.

This feature is of great importance in erosion control. When applied at the rate of 400 to 800 pounds per acre to the surface of a sloping newly seeded area, soil conditioners are very effective in controlling erosion until a grass cover can be established.

In experiments on several fields of corn, oats, wheat, and flax, applying up to 1,600 pounds of 25 per cent material did not result in any significant yield increases.

At the present time the use of soil conditioners is economically limited to rather specialized situations of limited area, such as for greenhouse, flower beds, gardens. It is a means of erosion control on newly seeded lawns, roadsides, and other problem areas.

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Fall Fertilization Compares Well with Spring

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CLIFTON F. HALSEY*

Average 1951 Crop Yields on Four Fields of Corn, Oats, and Hay as Affected by Different Times of Fertilizer Application

	Corn		Oats		Hay		
	Fall	Spring	Fall	Spring	Summer	Fall	Spring
	bushels per acre				tons per acre		
Untreated	69.9	68.5	33.8	34.2	2.5	2.1	2.3
0-40-0	71.6	72.3	33.7	35.1	2.9	2.8	2.9
0-40-40	74.1	69.4	37.5	36.3	3.1	3.1	3.1
40-40-40	78.4	78.1	50.6	49.7	3.4	3.4	3.6

MOST of the commercial fertilizer used in Minnesota is applied in the spring at planting time. This practice has been built up over the years on the assumption that fertilizer applied in the fall would be subject to considerable fertility loss by washing, leaching, and fixation during the winter months.

With the general increased use of fertilizer, spring application has become more of a problem to both the farmer and to the fertilizer producer. It requires extra time for the farmer during the busy spring seeding season, while the manufacturer must have large storage facilities and rapid handling methods which are taxed to capacity during the late winter and early spring.

A spreading of the work load more evenly for both producer and the consumer would be highly desirable, if practical. For some years it has been well known that the top dressing of hay lands during the summer and fall could be profitable, but no direct comparison with spring fertilizer application had been made.

No recent investigations had examined the comparative effectiveness of fall and of spring fertilization on either small grains or on corn. In the case of corn, it is well recognized that hill or band placement of the fertilizer is more efficient than broadcast applications. Therefore, fall fertilizer applications for a succeeding corn crop should be considered only when the farmer wished to exceed the fertilizing rate capacity of the planter fertilizing attachment which is approximately 200 pounds of fertilizer per acre.

During the summer of 1950, the Department of Soils commenced experiments to determine the relative effectiveness of fertilizer applied to four fields of legume-grass hay mixtures in the summer and in the fall, compared to similar treatments made early in the following spring. The fertilizer treatments used were as follows:

1. Phosphate alone—200 pounds of 0-20-0 per acre (0-40-0)

2. Phosphate and potash—200 pounds of 0-20-20 per acre (0-40-40)

3. Nitrogen—phosphate—potash—400 pounds of 10-10-10 per acre (40-40-40)

In addition, the effect of fall and spring fertilization treatments was tested on four oat fields, one wheat field, and four corn fields. Most of the experimental fields were located on the more sloping lands of southeastern Minnesota with the fertilizer being applied to the plowed land as a topdressing in the fall previous to being in a small grains or corn in the following year. The fertilizer was left exposed on the soil surface over the winter months to provide the best conditions for maximum fertility losses by blowing, washing, or leaching. Yields were obtained on the 1951 crop on all fields, with hay yields being based on two cuttings.

A summary of the comparative yields is included in the table above. Since yields on only one wheat field are available, these results were not included although similar trends were obtained on the wheat yields.

The results would indicate that crop yields with summer and fall fertilization compare well with similar fertilization in the spring. This finding has been further substantiated by subsequent experiments conducted by workers at the Iowa Agricultural Experiment Station based on 1952 crop yields.

During the summer of 1952 additional trials were commenced in Minnesota, using the same fertilizer rates and times of application. The results will not be available until the late fall of 1953.

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