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EC252 Revised 1951 Practical Explanation of Some Terms in Animal Nutrition

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Revised

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Practical Explanation of

Some Terms In Animal Nutrition

Vitamin B₁₂
Antibiotics
Amino Acids
Urea

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Practical Explanation
of
Some Terms in Animal Nutrition

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1. WHAT WAS MEANT BY THE TERM APF?

The letters APF were taken from the words A(nimal) P(rotein) F(actor). In the early studies of rations composed only of products of plant origin, poor results were obtained. These results could be improved by adding protein supplements of animal origin to the rations. Thus it was concluded that the supplements of animal origin contained an unknown substance or group of substances essential for proper nutrition. This substance or group of substances was then referred to as the animal protein factor. The term animal protein factor is a misnomer because it is not a protein. As a result this term has been discarded officially. (See paragraph 7)

2. WHAT IS VITAMIN B₁₂?

In April, 1948, the isolation of vitamin B₁₂ was announced. It was immediately apparent that this new vitamin was at least a part of the entity which originally had been termed APF. It is probable that other vitamins will be identified later. Whether these will be of practical significance in formulating the commonly fed animal rations is speculative.

3. WHAT ARE SOURCES OF VITAMIN B₁₂?

Feeds of animal origin contain vitamin B₁₂, however, the amounts present are variable and sometimes cannot be relied upon to furnish the animal's needs. Liver meal, fish meal, fish solubles and some packinghouse by-products are among the animal feeds containing relatively large amounts of this vitamin. A more reliable source of vitamin B₁₂ is one of several products produced by carefully controlled fermentation procedures with microorganisms. Following the isolation of vitamin B₁₂ and the recognition that several of the fermentation products contained this vitamin,

feeding tests were conducted comparing these products as sources of vitamin B₁₂, with the pure vitamin. The results of these feeding tests which have been announced from time to time since January 1950 show that some of the fermentation products are superior to pure vitamin B₁₂ when added to rations. The reason for this is now clearly attributed to their content of antibiotics. These fermentation products are by-products produced in the manufacture of antibiotics and contain residues of the antibiotics.

4. WHAT ARE ANTIBIOTICS?

Antibiotics are drugs of various kinds produced by carefully controlled fermentation procedures with microorganisms. They are not classed as nutrients. These drugs have been extremely useful in the treatment of various human and animal diseases. Some of the more commonly known antibiotics are: penicillin, streptomycin, aureomycin and terramycin.

5. ARE THE ANTIBIOTICS OF ANY VALUE IN SWINE RATIONS?

Many tests conducted to date show clearly that some antibiotics stimulate the growth of pigs under certain conditions. Tests have also shown that some of them are very effective in controlling certain types of scours in pigs. The antibiotics studied thus far which appear to be the most effective for swine are terramycin, aureomycin and penicillin. Streptomycin is also effective in some cases. Future tests will probably show that other antibiotics are also effective. These antibiotics stimulate the growth of pigs in dry lot fed rations that previously have been considered excellent rations. In certain cases, they appear to be of even greater benefit to young unthrifty pigs that have a tendency to scour. Several theories have been proposed as to how the antibiotics exert their influence. One theory is that they inhibit the growth of harmful intestinal bacteria. This may either allow beneficial bacteria to multiply and have a favorable effect on the animal or may merely clear up a low grade infection which may

or may not be outwardly noticeable. A second theory is that the comparatively low levels of antibiotics required to increase growth actually stimulate the growth of beneficial bacteria. A third theory is that the antibiotics kill bacteria which may compete with the animal for certain nutrients which increase growth. It is probable that any one theory will not account for all of the benefit from feeding antibiotics and that a combination of factors is involved. All investigators agree that when antibiotics are effective, the feed consumption increases. This leaves a greater proportion of the consumed feed available for growth over that required for maintenance of the animal. There are several questions about feeding antibiotics which remain unanswered. It is not known whether they will increase the growth of pigs which are allowed to run behind cattle. The effectiveness of the antibiotics for swine on pasture also has not been adequately studied. The antibiotics are not cure-alls and should not be regarded as such. There is certainly no substitute for a good sanitation system. It is not known whether the antibiotics will increase the growth of completely disease-free swine raised under ideal conditions.

6. HOW CAN I BUY ANTIBIOTICS AND VITAMINS B₁₂?

The use of crystalline (pure) antibiotics in feed mixtures is under the control of the Food and Drug Administration and is permitted only for research purposes by qualified investigators. An individual can buy crystalline antibiotics on the prescription of a medical doctor or a veterinarian but the cost of them and of crystalline vitamin B₁₂, is prohibitive. The only practical way to obtain these materials is to buy them as they occur in antibiotic and vitamin B₁₂ feeding supplements. These supplements have been added to many of the commercial swine feeds. Some feed dealers will sell the antibiotic and vitamin B₁₂ feeding supplements to farmers who wish to mix their own feed. Some of the manufacturers of these supplements do not sell directly to individual farmers or feeders.

7. HOW CAN I BE SURE OF THE ANTIBIOTIC AND VITAMIN B₁₂ POTENCY OF THE FEEDING SUPPLEMENTS?

The Association of American Feed Control Officials, after consulting the U. S. Food and Drug Administration, recently discarded the term "Animal Protein Factor Supplement" and replaced it with definitions of vitamin B₁₂ supplements and antibiotic feed supplements. After January 1, 1951, the use of the term APF in defining a feeding supplement is illegal. The following definitions are now official.

Vitamin B₁₂ Supplements: Feed supplements used for their vitamin B₁₂ content and for which there are no established definitions. The number of milligrams of vitamin B₁₂ activity must be declared on the label. Each pound of such supplements must contain a minimum of 1.5 milligrams of vitamin B₁₂ activity.

Antibiotic Feed Supplement: Feeding materials which contain single antibiotics or combinations of antibiotics having growth-promoting properties. The name and quantity of each antibiotic shall be declared on the label. Each pound of such supplements must contain a minimum of 1.0 gram of antibiotic. Directions for use shall not provide for the addition of more than 50 grams of antibiotic per ton of finished feed. The label must bear the legend - "For nutritional use only".

Combination vitamin B₁₂ and antibiotic feed supplements must meet the accepted standards for the separate supplements. Nebraska feed manufacturers are not required to declare the quantity of antibiotic or vitamin B₁₂ on the label of mixed feeds containing these supplements.

8. HOW SHOULD I FEED THE ANTIBIOTIC AND VITAMIN B₁₂ SUPPLEMENTS TO SWINE?

In several tests showing the growth-promoting value of antibiotics for swine, they have been effective when added either to mixed rations or to protein supplements fed free-choice with grain. There have been relatively few feeding tests comparing different levels of antibiotics. Even the results from these have not always agreed. It appears that under different conditions the optimum levels to feed may be different. This may also be true of the effectiveness of the various antibiotics. Until more exact information is obtained, if antibiotics are incorporated in swine rations, the manufacturers' recommendations should be followed. It may be learned later that the levels causing maximum growth may not be optimum with regard to feed efficiency and economy.

The vitamin B₁₂ requirement for swine may vary under different conditions. It is less when there is a carry-over effect from the gestation and suckling periods. The addition of from 15 to 20 milligrams of vitamin B₁₂ per ton of mixed feed is probably adequate under most conditions. There are some indications that the requirement is considerably below this figure. If there is a large carry-over in previously well nourished pigs or if the ration contains feeds of animal origin the supplementary level of vitamin B₁₂ can be decreased accordingly.

9. IS THERE ANY DANGER IN THE USE OF THE ANTIBIOTICS FOR FEEDING?

This problem has not been studied adequately. It appears that at the levels recommended by the manufacturer the use of the antibiotics for feeding is not dangerous either to the animals or to humans consuming their carcasses. Several studies in which brood sows have been fed antibiotics indicate that there are no adverse effects on reproduction. The effect of feeding antibiotics on the carcass composition of swine is not definitely known, although

there are some indications that they increase the proportion of fat. If this is true, it is probably because of the increased feed consumption and gain and not because of any direct affect of the antibiotics.

10. WILL FEEDING VITAMIN B₁₂ SUPPLEMENTS ELIMINATE THE NEED FOR USING PROTEIN SUPPLEMENTS OF ANIMAL ORIGIN?

Tests have shown that supplementing rations with vitamin B₁₂ reduces the need for feeds such as tankage, meat scraps, fish meal, etc., however, it is probable that some feeds of animal origin contain essential nutrients which have not yet been identified. These nutrients may not be of importance in the nutrition of previously well fed pigs over relatively short feeding periods. They should be kept in mind, however, when considering swine nutrition from the time of breeding the sow to the marketing of her pigs. Important advantages of vitamin B₁₂ supplements are their ability to extend the supplies of animal protein feeds and to insure an adequate level of vitamin B₁₂ in the ration. Some feeds of animal origin do not supply sufficient vitamin B₁₂ under certain conditions.

Another point which should be considered is that tankage and meat scraps are by-products of our own industry. Not to make use of these products would be wasteful and would make our live animals worth less on the market. In addition, the animal products are good sources of minerals and known vitamins in addition to vitamin B₁₂. These sources of known vitamins, however, are becoming less important as newer research methods permit the economical addition of synthetic vitamins to rations. It is important to remember that any decrease in the animal protein content of a ration must be accompanied by rebalancing the ration with respect to minerals and vitamins and a consideration of the amino acid composition of the protein in the ration.

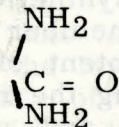
11. WHAT ARE AMINO ACIDS?

Amino acids are the "building blocks" of protein. Each molecule of protein (the smallest particle of protein) is composed of many smaller compounds called amino acids. There are more than 20 of these amino acids. The distinguishing characteristics of different proteins are the kinds and proportions of the different amino acids and the manner in which they are combined to form the molecules of proteins. During the processes of digestion proteins are broken down to their constituent amino acids. The amino acids then pass into the blood stream and are recombined to form either blood protein or body protein. Those which are not needed by the animal are broken down and their end-products are either used for energy or are excreted in the urine, principally in the form of urea.

Since the animal needs certain of the amino acids in definite proportions to build its tissue, the proteins which are fed must furnish the correct combination of amino acids (See paragraph 17 for exception in the case of cattle and sheep rations). Some proteins are low in particular amino acids while high in others. By feeding swine and poultry more than one protein it is possible to furnish the combination of amino acids required for growth.

12. WHAT IS UREA?

Chemically, Urea is the diamide of carbonic acid. It has the following structure:



Urea is the principal end product of nitrogen metabolism in mammals. Thus it is found in the urine of all four-legged farm animals and man. Urea in abnormal amounts is toxic to the animal.

In normal animals the urea resulting from protein metabolism is dissolved in water and excreted without harm. But, the need for the body to eliminate this waste explains why animals on a high-protein diet (there is more waste) drink more water than animals on a low protein diet.

13. WHAT IS THE SOURCE OF UREA USED IN FEEDS?

Urea is manufactured by some of the large chemical manufacturing firms. In this process nitrogen is taken from the air. Urea is usually mixed with a small amount of other material to prevent caking in storage. One such product is Dupont's 262. It is thus named because it has a nitrogen content equivalent to 262% protein. Pure urea contains a bit over 48% nitrogen and thus its protein equivalent would be approximately 290% (48×6.25). To obtain the protein content of any feed, the nitrogen content is determined and this value is multiplied by 6.25, because the average protein contains 16% of nitrogen ($100 \div 16 = 6.25$).

14. WHAT DOES UREA LOOK LIKE?

It is a white crystalline material, and as marketed (mixed in a carrier) is free-flowing.

15. CAN UREA REPLACE PROTEIN IN FARM ANIMAL RATIONS?

Urea can be used to replace part of the protein in suitable rations for ruminants. The research results to date are somewhat variable. In some experiments excellent results have been obtained, in others just fair results.

16. IS UREA OF ANY VALUE IN SWINE OR POULTRY RATIONS?

No! They do not have the type of digestive tract that can make use of this material. Tests have shown though, that urea in the amounts recommended for cattle is not poisonous to swine or poultry.

17. HOW IS UREA UTILIZED BY RUMINANTS?

Studies have shown that cattle and sheep utilize urea in certain rations through the action of bacteria in the paunch. The bacteria, when properly nourished otherwise, are able to convert urea into their own body proteins. As the bacteria pass on through the digestive tract they are digested by the animal and the amino-acids of the bacteria protein are utilized by the cow or sheep.

For the bacteria to make this conversion of urea to amino-acids to protein, the ration fed the cow or sheep must contain readily available carbohydrates and it must also contain some protein as such. The presence of protein promotes the activity of the bacteria as well as supply amino-acids that supplement those of the bacterial protein.

18. WHAT ARE THE LIMITATIONS ON THE USE OF UREA?

An excessive intake of urea is poisonous because of the ammonia produced from it in the rumen. Studies indicate that urea should not be fed at a greater rate than 1 per cent of the total dry matter of the ration or 3 per cent of the concentrate mixture.

The conversion of urea to protein is poor when urea is added to a hay ration, and no concentrates are fed. The conversion is good when urea is added to a concentrate mixture which contains a fair amount of cereal grains. The conversion is poor when the ration consists of molasses and grass hay plus urea.

19. ARE ANY OTHER PRECAUTIONS NECESSARY, OTHER THAN LIMITING THE AMOUNT FED?

Yes! Urea to be used successfully must be carefully mixed so that it is uniformly distributed throughout the mixture. If it is not uniformly distributed one animal may get enough to be poisoned. In general, the commercial feed manufacturers are much better equipped to do this job properly than most feeders.

It must be borne in mind too that urea supplies no energy, no minerals and no vitamins to the ration. Protein supplements do supply these other nutrients in varying amounts.

When urea is substituted for part of the protein supplement these other nutrient essentials have to be supplied in other ways.

Urea is not of much, if of any, value in a ration that already contains sufficient nitrogen in the form of protein.

Much research must yet be done before all the questions concerning urea can be answered.

10. IS UREA AVAILABLE?

Urea is manufactured in large quantities and can be obtained from feed manufacturers and (probably) directly from DuPonts, and perhaps others.