

Nutrition Studies on Cottonseed Meal

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AT the May, 1929, meeting of the Interstate Cottonseed Crushers' Association a very extensive outline was adopted as a guide to a series of nutrition studies to be carried out in cooperation with the Bureau of Chemistry and Soils of the United States Department of Agriculture. In accordance with this outline, plans were laid last August for a comprehensive program of investigations which would provide new information of more than theoretical interest and which would lead toward the solution of some of the problems related to the feeding of cottonseed meal. The history of the use of cottonseed meal as a feedingstuff has been given by Macy².

Although this investigation was undertaken mainly to determine the nutritional value of the proteins in cottonseed meal, and this paper is really a progress report on this work, information on other nutritional factors in cottonseed meal have come to light. Our experiments have demonstrated that commercial cottonseed meal contains in unexpected abundance two well known vitamins, vitamins B and G. These vitamins are essential for the growth and development of man and many animals, but since their names carry no significance as to their properties you may wish to know some facts about them before considering the results of our experiments.

Vitamin B is a water and alcohol-soluble substance of unknown composition widely distributed in plants and grains in varying amounts. A deficiency of this vitamin in the diet is indicated by an early failure in growth, loss of appetite, and in man, if the deficiency is marked, there follows a serious and complex type of nervous degeneration leading eventually to the disease beriberi. A similar disease can be produced in animals.

The disease pellagra is probably familiar to some extent to all of you who have lived in the South where this malady has at times developed to endemic proportions, but you may not be familiar with the fact that in 1926 Dr. Joseph Goldberger of the Hygienic Laboratory, United States Public Health Service, demonstrated that this disease is owing to the lack of a specific substance in the diet. This substance, also of unknown chemical composition, is now called vitamin G. Lean meat, fish, eggs, and milk are known to be good sources of this factor.

In the experiments I am about to describe, albino rats were used, as for many reasons these animals are now recognized as being most suitable as test animals in nutrition experiments.

Experimental Program

THE first problem of the general program that we planned to attack is that concerned with the nutritive quality of the proteins as they come to us in commercial cottonseed meals. The results of such a study will lead to information of immediate practical value and furthermore will serve as a groundwork for other phases of the investigation. One method of determining the biological value of a protein is to provide the experimental animals with a diet that is satisfactory in all respects, except that it contains no protein or other nitrogen-bearing material, and then determine how much of the material under investigation, cottonseed meal in this instance, must be added to the diet to produce the desired response in growth rate. Information obtained from such experiments points the way to an intelligent selection of other protein concentrates to supplement just those protein deficiencies that may occur in the protein under investigation.

Since the growth rate of the animals is one important criterion in the study of the nu-

¹ Working under fellowship of the National Cottonseed Products Association.

² Historical Notes on Cotton Seed as Food. By I. G. Macy. *J. of Dairy Science*, vol. 4, 1921, p. 250.

tritive quality of any new substance, it is obvious that all substances other than the one under test must be supplied in abundance. It is always necessary, therefore, to include in the ration of the experimental albino rat some ingredient that will provide an adequate quantity of the two essential factors which I have described, vitamins B and G. A deficiency of either of these vitamins leads to an early and abnormal slowing of the growth rate and eventually to the development of specific diseases, as previously indicated.

As yet, vitamins B and G cannot be prepared in such degree of purity that the concentrates do not contain nitrogenous constituents of unknown nature and the inclusion of these materials would of necessity invalidate a clear-cut evaluation of the proteins under investigation. Therefore, our protein studies would be more conclusive if the cottonseed meal we were feeding as a source of protein would at the same time serve as an adequate source of the water-soluble vitamins.

Our first experiments, therefore, were designed to demonstrate how low a level of cottonseed meal could be used in the diet as the sole source of these vitamins and still provide them in entirely adequate quantities to permit growth at the maximum rate. The results indicated that cottonseed meal is an unusually rich source of both vitamins B and G. This unexpected fact warranted further investigation of the quantitative relations of each vitamin, B and G. Accordingly, experiments were undertaken to bring out to what degree commercial cottonseed meal would compare with the best quality of pure, dried yeast of known vitamin potency. Yeast is taken as our standard since it has been and is today by far the richest natural source of both vitamins B and G.

Vitamin-Content of Meal

IN one ration 5 per cent of cottonseed meal constituted the sole source of the water-soluble vitamins. A control ration carried in addition 5 per cent autoclaved yeast which we had previously shown to be free from vitamin B but a good source of G. At this low level of cottonseed meal the growth rate was fair, the rats receiving the vitamin G supplement showing the better response. When the level of cottonseed meal was increased to 10 per cent the growth rate approximated the optimum and the addition of vitamin G produced but little response. These experiments have demonstrated that commercial cottonseed meal even in the unrefined state approximates yeast

as a source of both these vitamins, and so far as we know now it is the only substance that does.

As regards farm animal feeding our demonstration is ahead of the story, for we do not yet know to what extent animals other than the rat and dog are dependent upon these factors for normal growth and development.

This work on the water-soluble vitamins is a valuable and interesting by-path that was followed while laying the foundation for a thorough investigation on the nutritive quality of the cottonseed proteins as they appear in the commercial meals. In the protein phase of the program also we feel that creditable progress has been made, although our data are inadequate at present to make any quantitative interpretations. We have constructed for our animals a suitable diet in which cottonseed meal provides the only source of protein. Carbohydrate and energy requirements are met by including dextrinized cornstarch; the minerals are balanced by using a combination of chemically pure salts. Vitamins A and D are supplied in a low level of 2 per cent of cod liver oil of tested potency. Since we have established the potency of the cottonseed meal in vitamins B and G, we no longer need to complicate our interpretations by including a component that would bring another source of proteins into the experiment.

Preliminary trials indicate that the cottonseed meal provides proteins of exceptionally high quality. Until we have had time to compare meals from different sections of the country prepared under somewhat varying conditions, however, we shall not be justified in making any broad statements about this phase of the work.

I would not consider this report of progress complete without a word of tribute to the excellent facilities and whole-hearted cooperation that I have enjoyed in the Protein and Nutrition Division of the Bureau of Chemistry and Soils. Progress in a problem involving the use of laboratory animals cannot be made by independent industry. The nature of this work makes many and unusual demands on the staff and necessitates extra or special equipment. It is no exaggeration to state that there is no laboratory in the country better equipped and but few as well equipped for this work, and the Association has the further advantage of knowing that the work is done in cooperation with some of the most able men in the field of nutrition.