# Processing for Nonruminant Feed Markets[1]

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## ABSTRACT

Processing methods can be controlled to provide a cottonseed meal that is improved nutritionally and substantially free from toxic principles. In so doing, cottonseed meal can be fed beneficially to cattle, poultry, swine, and even trout. It is, therefore, possible to feed cottonseed meal to animals and poultry up to 10% of their dietary levels without harmful effects like minimizing their growth, reducing their bone marrow, harming their spleens, or discoloring their egg yolks. It is, however, necessary to prove to those who might use the meal that the feeding is economically sound and as productive as other meals.

## INTRODUCTION

This topic could be expanded to include many oilseed crops. However, this article is limited to the processing of cottonseed. The varying principles discussed here can be adapted to other oilseeds as well. Since I am not a technical man, I will confine my observations to the viewpoint of management.

At Ranchers Cotton Oil, the prime source material is cottonseed, although we have processed other materials. Processing of agricultural products is far from being an exact science; however, it apparently needs the scientific approach. Vegetable oilseeds vary in quality and contents, not only from year to year, but also from the beginning of the harvest season to the end of a harvest season. Adapting processing principles, therefore, becomes one of compromise–how to reduce the objectionable features to their minimum and how to maintain the best qualities at a maximum.

We have found that the best place to start to make quality products is at the source which, in our case, is at our cotton gins where we try to preserve and have delivered to us the best quality cottonseed possible. We then see that it does not go out of condition and that it contains a minimal amount of foreign materials. Our experience has proven that leaves, sticks, etc., are hosts for bacteria and fungus that cause deterioration in stored seed. It is impossible and impractical to clean the cottonseed at the oil mill before storage. We pay for seed on the basis of grade. It is, therefore, to the gin's advantage to deliver the cleanest and driest seed possible.

Many years ago, we felt that cottonseed protein could be produced and used in the poultry markets. However, the basic objection was that it contained gossypol, a color gland that, when not removed or rendered inactive, had a toxic effect upon the feeding of meat birds and could result in discolored eggs from laying hens. Since then, in our studies, we found that solvent extracted cottonseed meal was too dusty and feeders wanted something low in fiber with a protein that would be comparable in its nutritive qualities to other available sources. In other words, the customer wanted an economical feed with high efficiency at a price that would make him money. We found out that our customer was really a computer. It is necessary to supply a computer with facts about your product (1,2).

[1]One of seven papers presented at the symposium, "Processing Methods for Oilseeds," AOCS Spring Meeting, April 1973.

## PROCESSING STAGES

During the last 20 years, one step has led to another, and none of these processes and problems were solved overnight. We actually go through ten stages of processing to produce a finished cottonseed meal. Some of these stages are designed primarily for the extraction of oil and here again we have a compromise. These stages are: cleaning; delinting; separation of hulls; conditioning with moisture; rolling; cooking; prepressing; solvent extraction; desolventizing; and screening, grinding, and fractionation.

The reason for cleaning is obvious. In separating the hulls from the meats, we control the protein percentage by the amount of hulls that we leave. We condition with moisture before rolling so that we can have what is known as a wet cook. This is the first step of breaking the glands and the removal of gossypol. If it is too wet, we cannot prepress it; if it is too dry, we do not accomplish our purpose. We try to maintain 16% moisture to the cookers. Between cooking and prepressing we add soda ash. This is added primarily for the control of the free fatty acid through processing and later refining; but, as a result, the finished cottonseed meal has a pH of 7.1 or 7.2 and we have not experienced any moldy or cakey meal since we started doing this. Most molds found in oilseed and feedstuff have their optimum growth in high moisture, temperatures between 96 and 112 F, with the host having a pH between 4 and 7.

All through our processing, we endeavor not to apply excessive heat which would reduce the protein quality. Cooking temperatures never exceed 220 F; the prepressing is at a rate that does not cause excessive friction heat; and the desolventizing is likewise controlled at levels just high enough to drive off the solvent. We have sampled before and after each of the various steps of processing, i.e. cooking, prepressing, extraction and drying, to determine the effect that each of these stages of processing has upon the final product. Straight screw-pressing usually results in protein solubility in the low 50%. Using the protein solubility method of analysis, we try not to be below 75%.

During the meal desolventizing process we add back the soapstock from our refining process which reduces the dustiness of the meal. In the meal room, we found it better to screen and only grind the overs. This eliminates 80% dust.

Most of the work done by plant breeders in developing the strains of cottonseed had been directed toward the quality and yield potential of the lint. In recent years, these breeders have paid more attention to the reduction of the gossypol content of the seed and the quality of the protein that is available. We are fortunate in having a One Variety Cotton Law, and our breeders have had seed quality in mind in all of the work they have been doing. For oilseed processing, the ultimate would be a cottonseed that has good lint quality and yield potential but is a glandless seed with essentially no gossypol content. We then could produce protein for the food market. In the meantime, however, we must do the best we can with what we have to work with.

## AFLATOXIN

There is one other objectionable feature that has come to our attention recently and that is the presence of aflatoxin which originates in the field. Aflatoxin, like other

molds we find, proliferates in warm, moist, acidic environments. To eliminate these three conditions, which incidentally are one of the causes of hot seed, we do three things. To any seed received with high moisture that must go into storage, we add a mold inhibitor which is either calcium or sodium propionate and then cool and dry with air suction to temperatures of 70 F or below and, hopefully, moisture to 8% or below. Molds such as *Aspergillus flavus* which produces aflatoxin apparently do not multiply under these conditions.

Aflatoxin originates in the field. These protective steps we take in storage will not eliminate it but will prevent subsequent formation of mold and aflatoxin in the seed or meal. If the seed or meal is too highly contaminated, the only known commercially practiced remedy is ammoniation of either. Ammoniation is the addition of ca. 1%, by wt, of anhydrous ammonia in a pressure reactor under moist conditions. Feeding tests sponsored by Ranchers Cotton Oil have been made on our ammoniated meal by Washington State University, Prosser; University of California, Davis; and California State University, Fresno, starting in 1963. These tests indicate deactivation of aflatoxin and beneficial results in feeding to ruminants. Further tests are being made on poultry.

## FEEDING TESTS

I sometimes think we are working for the chemists, although we have found that we cannot do without them. Our chemists make many tests to ensure efficiency in production and quality control for the end product; plus they engage in many hours of research. The tests for the finished meal include: moisture content, oil content, protein, free gossypol, nitrogen solubility, pH, and crude fiber. All of these processing methods and the analytical methods really are not worth anything unless the customer will accept and use the products. With feeding trial tests for both meat birds and laying hens, we were able to prove to this computer that cottonseed meal with the requisites of proteins of either 41%, 44%, or 50% of cottonseed meal; with a nitrogen solubility of at least 75%; and with an available gossypol unit of 0.25 or less could be fed in up to 10% ration without any ill effects and with excellent results.

These feeding tests were conducted by the University of California, Davis, followed by feeding tests in our own chicken farm in the laboratory. For 15 years, the only known method of testing was to feed the chickens then analyze the eggs. Experience has enabled us to discontinue this test.

### REFERENCES

1. Cavanagh, G., JAOCS 34:537 (1957).
2. Halloran, H., Poultry Sci. XXXIX:18 (1960).

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