MICROSCOPIC IDENTIFICATION OF HYDROLYZED FEATHER MEAL

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American Feed Control Officials in 1958 defined hydrolyzed poultry feathers as "the product resulting from the treatment under pressure of clean, undecomposed feathers from slaughtered poultry, free of additives, and/or accelerators. Not less than 70 percent of its crude protein content shall consist of digestible protein."

Most of the processors over the country produce hydrolyzed feather meals which conform well to this definition.

Feather Structure

Feathers arise, as do the scales of reptiles, from dermal papillae with a covering of epidermis, and become enveloped in a pit called the feather follicle. A typical feather consists of a stiff axial rod, called the scapus or stem. The lower attached portion is hollow, semi-transparent, and is called the quill or calamus. The distal portion is called the vane, and the stem passing through it is called the shaft or rachis. The vane is composed of a series of parallel bars and each bar bears a barbule along either side. The barbules on one side of the barb have hooklets which hold the adjacent bars together.

The three principal kinds of feathers are: (1) the contour feathers or penae like the one just described; these possess a stiff shaft and firm vanes; (2) the down-feathers or plumulae possess a soft shaft and vane; they lie beneath the contour feathers; the bars of some down-feathers arise directly from the end of the quill, and no shaft is present; and (3) the filoplumes possess a slender hair-like shaft with few or no barbs.

Protein Composition

The protein in feathers belongs to a class known as "keratins." These proteins are insoluble in water, and are resistant to digestion by the proteolytic enzymes.

The insolubility of keratins is due in main to the fact they contain a high percentage of cystine. This complex amino acid, contained at a rather high percentage (6.9 percent) in feathers, can be made soluble and digestible by treating raw feathers under steam pressure and at a proper temperature.

The high level of cystine in feathers makes it a valuable protein supplement since the sulfur-containing amino acids are border-line or deficient in many useful animal feeds. Besides being a good source of cystine, feather keratins also contains large amounts of other essential amino acids.

Microscopic Identification

The hydrolyzing procedure results in changing the form of feathers, see Figure A. All evidences of normal structure found in raw feathers are lost if the product is completely hydrolyzed, Figure B. The ground-melted feather mass forms a light, soft textured, flakey-type meal which usually is dark gray to dark brown in color.
Figure A. HYDROLYZED FEATHER MEAL

Figure B. RAW FEATHER MEAL

(Rachis) - Raw, Not Hydrolyzed
Examination of the material under a compound microscope at 100 to 125X, shows it exists in irregular shaped particles, some long and tubular, some oval, some rectangular and flat-shaped, but each form has peculiar tube-like (vermiform) markings on the surface. Except for its size and color, the hydrolyzed feather mass may be compared in appearance to cooked spaghetti.

Some portions of the contour feathers, such as quill and rachis, may pass through the hydrolyzing process if it is not properly regulated. Some particles may also resemble hoof meal. The latter are due to over-processing and insufficient moisture.

Most hydrolyzed feather meals contain a small percentage of raw feathers. This is because the door on some types of cookers is recessed and will permit a few pounds of raw feathers to stay within that area and not be hydrolyzed. These raw feathers are forced out and mixed with the hydrolyzed batch once the cooker is dumped. Their presence in the mixture will result in lowering the quality of the total product because the protein they contain is highly indigestible.

It is possible for manufacturers to produce pure hydrolyzed feather meal. These, when examined microscopically, show no evidence of being over-processed, and no traces of raw feather fragments. Their digestible protein content range from 80 to 50 percent, some even higher. The ability of manufacturers to produce feather meals with digestible protein in the higher range depends on factors such as the type of feathers used, control of temperature, moisture content and the processing time.

Down-feathers, with soft shaft and vane, are the types easiest to hydrolyze; the heavy (contour) feathers, with a firm vane, hard quill and rachis, are the types most difficult to hydrolyze. Thus, it is evident that any batch of feathers containing a large amount of heavy (contour) feathers, will have to receive the extreme rather than the minimum treatment. This usually results in a lower digestible protein for the product because the soft down-feathers in the mixture break down early and are over-processed by the extreme treatment.

Over-processing lowers the digestibility of feather material and also lowers the yield of its total or crude protein. Thus, there is a tendency for manufacturers to either add some raw feathers back to the mixture or not attempt to completely hydrolyze all parts of the heavy-type feathers. They want to maintain the higher crude protein value because it will determine the price received for the product. After it is sold to some mixer, an analysis for crude protein may be made of the material, but it remains unlikely it will be examined microscopically for the presence of raw feathers or an analysis made for protein digestibility.

Results of analysis performed in our laboratory show that the better grades of feather meals (near 100 percent hydrolyzed) contain crude protein of 80 to 85 percent, of which 76 to 80 percent is digestible protein. Those containing crude protein much above 85 percent usually contain a great deal of raw feathers and have digestible protein content of 40 to 60 percent.

History

The process of using steam pressure and heat to convert raw feathers into useable products is not new. An application to patent the process was made by a company on January 27, 1945. The patent was granted on February 15, 1955. This patent gave the company exclusive rights to manufacture feather meal and this soon
led to a great deal of controversy. Other renderers, over the country, having an abundant supply of feathers and all the equipment needed to manufacture the product, could not produce hydrolyzed feather meal unless they paid royalties to that company on every pound of the product they might produce. The renderers as a group were successful in breaking this patent in 1957. Since then, several renderers have set up plants to process poultry feathers and poultry offal. Some of these plants operate on a dual basis; part-time is spent in processing the conventional products from animal meat waste, the rest of the time is given over to the processing of poultry offal and feathers.

Several factors, such as good prices received for the product and good demand for it, have encouraged this development. Perhaps the primary factor has been the great increase in industrial processing of poultry. These processors have poultry offal and feathers as by-products. To obtain the offal, renderers, as a general rule, have to dispose of the feathers. This they are happy to do since the converted feather meal will bring a premium price and its cost of production is no greater than that of other conventional meat waste products.

Manufacturing Process

The method used to manufacture hydrolyzed feather meal is essentially the same in various plants over the country. However, some variation does exist.

The general processing procedure followed is the same as the method developed by the Western Regional Research Laboratory and used by most producers of hydrolyzed feather meal. The method involves cooking the wet feathers under steam pressure and then drying them. In actual operation, the wet feathers are put into a dry melter-type cooker and heated by steam pressure to about 30 or 40 pounds for about 30 to 45 minutes. The pressure is then relieved and the protein material either dried in the same cooker or dumped and dried in some other type of drier. The processing cycles vary in different plants from about 1 3/4 hours to something over 9 hours, depending on the method of drying used. With the shorter drying time, a vacuum is used and very close control of temperature and pressure is maintained. Products from different producers have been very uniform in feeding quality when they were produced by this method.

References


