

FEEDING VALUE OF FISH MEALS

By Hugo W. Nilson*

INTRODUCTION

The feeding of poultry and swine is getting more complicated every day. This is because more and more animals are being kept in houses or on dry-lot or limited pasture all of the time; and also, gains in weight or production are expected to be both greater and cheaper.

The rations fed must contain all of the nutrients needed for rapid growth or high production in as inexpensive a combination as safety permits. The bulk of any ration is necessarily cereal grains. The concentrates used to supplement the cereal grains must be selected with care in order to obtain a balanced mixture.

These concentrates, which include fish meals, are used because they supply extra protein, certain vitamins, and some nutritionally essential minerals. Since it is not possible in this article to compare one concentrate with another (as to the nutrients each contains and the probable comparative values in respect to cost), this discussion will be limited to fish meals.



DRIED FISH SCRAP PRIOR TO GRINDING IN A CHESAPEAKE BAY MENHADEN REDUCTION PLANT.

* PHARMACOLOGIST, FISHERY TECHNOLOGICAL LABORATORY, BRANCH OF COMMERCIAL FISHERIES, U. S. FISH AND WILDLIFE SERVICE, COLLEGE PARK, MD.

KINDS OF FISH MEALS

Fish meals in the United States are of two kinds: (1) Those produced from whole fish, and (2) those prepared from scrap obtained in filleting, canning, or other fishery processing operations.

The whole-fish meals are usually made from menhaden on the East Coast, pilchards (sardines) on the West Coast, and herring in Alaska. The whole fish are usually cooked with steam and pressed in order to separate out the mixture of water and oil. The oil and so-called "stickwater" are separated by centrifugation. The oil is used as a carrier for vitamins (feeding oils) or for industrial purposes. Much of the stickwater is now concentrated to 50-percent solids and sold as condensed fish solubles. The pressed fish scrap is dried, ground, and sacked, and in this form is one type of fish meal that is used for feeding animals.

The scrap from filleting or other fishery processing operations may be handled in the same way as the whole fish if the oil content is sufficient to pay for separation. If not, the scrap is usually dried, ground, and sacked. Meal when made from groundfish fillet scrap is commonly called white-fish meal.

Sometimes, of course, mixed meals are made from any raw material on hand. This is particularly true when whole so-called trash fish (species of fish which have limited or no sale as food fish) are mixed with production or processing scrap.

PROXIMATE CHEMICAL COMPOSITION

The proximate chemical composition gives some idea of the feeding value of fish meals. The principal nutrient is crude protein (nitrogen x 6.25). This amounts to 55 to 70 percent by weight. The scrap meals usually contain the least and the herring meal the most protein. The bulk of the meals contain 60 to 65 percent protein by weight.

The price of fish meal is usually based on protein content. Most meals are sold to the wholesale trade at a quoted price per protein unit. The protein unit is the percent of protein on a ton basis. A quotation, for instance, of \$2.50 per protein unit for a 60-percent protein meal, means that the price is \$150 a ton f.o.b. at the loading station listed in the quotation.

Although the protein content usually determines the price of the meal, this does not mean that protein is the only nutrient. Fish meals also contain about 8 percent of crude fat and 4 percent of nitrogen-free extract. These two nutrients supply calories, which although useful, can be supplied as well by cereals. They contain less than 1 percent of crude fiber. Fish meals, therefore, can also be classified as desirable low-fiber feeds for inclusion in the "high-energy" rations used for feeding rapidly-growing poultry and swine.

The mineral content of fish meals varies from about 12 percent for high-protein meal to about 33 percent for low-protein meal (about 55 percent). Most of the mineral content can be used by the animals. The nutritionally essential minerals supplied by fish meals are calcium, phosphorus, iron, copper, and some trace elements. Few studies have been made to find out the exact composition of the mineral matter, but since most of it comes from the bones of the fish, there should be no reason why the inorganic elements should not be well utilized by the animal.

The proximate chemical composition shows that the principal nutrients in fish meals are protein and minerals. Fish meals also have a desirable low-fiber content.

PROTEIN OF FISH MEALS

Biochemical studies further show that the protein in fish meals is of exceptionally good quality. Chemists have shown that a protein is made up of about 20 different amino acids. Ten of these are necessary in order for the animal to use protein efficiently, and these must be supplied by the feed at each feeding in certain minimum quantities since the animal cannot manufacture them. These are the so-called essential or indispensable amino acids. Some of the other 10 or more amino acids are very necessary too, but the animal can make them in the quantity needed if enough protein is fed.

There is no exact information on the kind and quantity of amino acids needed by poultry and swine. Based on feeding tests with rats, the following amino acids are considered essential, and three typical analyses are given for fish meals:

Amino acid	% by weight of protein*			Amino acid	% by weight of protein*		
	A	B	C		A	B	C
Tryptophane ..	0.9	1.2	1.3	Leucine	9.4	10.0	7.1
Lysine	8.0	5.7	7.8	Isoleucine	6.7	4.0	6.0
Methionine ...	2.8	3.0	3.5	Valine	5.9	4.0	5.8
Threonine	5.1	5.0	4.5	Histidine	2.4	2.4	2.4
Phenylalanine.	4.4	4.8	4.5	Arginine	7.9	5.9	7.4

*Grams of amino acid per 16 grams of nitrogen.

- A. Deas, Ney and Tarr 1950
- B. Block and Bolling 1945
- C. Block and Mitchell 1946

These analyses indicate that fish meals contain all of the essential amino acids in amounts which should permit rapid growth, maximum production, and efficient utilization of feed if the other nutrients are available in sufficient amounts.

The so-called dispensable amino acids are glycine, alanine, cystine, serine, tyrosine, norleucine, aspartic acid, glutamic acid, hydroxyglutamic acid, proline, and hydroxyproline. Recent feeding experiments have shown that it is necessary to have an adequate supply of this last group of amino acids at each feeding, as well as the so-called essential ones, in order to get efficient utilization of feed protein.

Only a few scattered analyses are available which give the amounts of the dispensable amino acids in fish meals, but these indicate that fish meals compare favorably with other animal protein byproducts in this respect.

On the basis of biochemical analyses and extensive feeding tests it can be concluded that fish meals are an excellent source of animal protein, containing all of the amino acids in sufficient amounts to permit rapid growth, maximum production, and efficient use of the feeds when fed at a level of at least three percent in most rations. The protein of fish meals is an excellent balancer for the protein of cereal grains and cereal byproducts.

VITAMIN CONTENT

A few years ago it was adequately demonstrated that if poultry or swine were fed a ration consisting essentially of plant materials (such as corn meal and soybean meal), together with vitamin or mineral supplements, maximum rate of growth could not be obtained without the use of some animal protein in the ration. It was

found that milk, meat products and, in particular, fish meal contained something that was not protein in nature but was essential for growth of the animals. Following the isolation of vitamin B₁₂ from liver extract and the demonstration of the value of this vitamin in the treatment of pernicious anemia, it was shown that vitamin B₁₂ would produce essentially the same effect as the substance present in animal-protein supplements that had been named the animal protein factor (APF). There is some evidence indicating that fish meals contain other factors in addition to vitamin B₁₂.

Fish meals contain from one-tenth to one-third of a milligram of vitamin B₁₂ per pound. A ton of poultry feed should contain at least 12 milligrams and a ton of swine feed at least 20 milligrams of vitamin B₁₂. It has been found that 60 to 100 pounds of fish meal per ton of poultry or swine feeds will supply enough vitamin B₁₂ and the unidentified factors for satisfactory growth. More than this quantity can oftentimes be used to good advantage to increase production and secure the best utilization of rations.

In addition to vitamin B₁₂ and the unidentified growth factors, fish meals contain about 3 milligrams of riboflavin, 30 milligrams of niacin, 3 milligrams of pantothenic acid, and 1,500 milligrams of choline per pound. These vitamins, too, are concerned with promoting growth and production, and the efficient utilization of feed.

SUMMARY

Fish meals are an excellent source of high-quality animal protein, certain necessary vitamins including vitamin B₁₂ and other growth factors, and nutritionally essential minerals (particularly calcium, phosphorus, iron and copper). The high protein content (from 55 to 70 percent) and low-fiber content make fish meals a particularly good ingredient for "high-energy" rations for rapidly-growing poultry and swine.

Fish meals may also be included in all rations for breeding animals to advantage since they efficiently balance the low-cost cereal or cereal byproducts which make up the bulk of these rations.

Since fish meals are an excellent source of high-quality animal protein, certain essential vitamins, and nutritionally necessary minerals, they assist materially in the compounding of feeds to secure rapid growth, greater production, and the economical use of rations. In other words, the various fish meals are superior feed ingredients.

