DEVELOPMENT OF VOLUNTARY FEDERAL STANDARDS OF GRADE FOR FRESH AND FROZEN FISHERY PRODUCTS

Voluntary United States Standards are yardsticks with which the quality of a product is measured. They are developed by the Federal Government in cooperation with the producers, processors, distributors, and consumers, and are recommended officially for optional use.

More than 126 United States Standards for processed and fresh food commodities are in effect, and the quantities of foods officially graded amount to billions of pounds. Fresh and frozen fishery products are exceptional in that they do not have voluntary United States Standards of quality as aids to efficient buying and selling.

The grading and inspection programs of the Federal Government have been beneficial to industry and consumers in reducing confusion, waste, and fraud. They have been aids to warehousing, financing, and marketing of foods, and have helped producers and distributors in the development of more and bigger markets; i.e., the uniform improvement of quality of poultry, brought about largely by the U.S. Department of Agriculture poultry inspection and grading service, has resulted in a rapid increase of domestic consumption of broilers and farm chickens from 0.7 billion pounds produced in 1939 to $1\frac{1}{2}$ billion pounds raised in 1952.

At a meeting of the National Fisheries Institute in the spring of 1954, the major producers and distributors of fish sticks requested the U. S. Fish and Wildlife Service to conduct research to develop voluntary standards for fish sticks.

Loading a refrigerated truck with outgoing shipment of fish in Chicago's Fulton Market.

The Saltonstall-Kennedy Act (PL-466) provided funds for a substantial expansion in this project to develop voluntary Federal standards of grade and condition for fresh and frozen fishery products.

The development of background information on the cooked fish sticks has been carried out at the Service's technological laboratories in Boston and in Seattle. Extensive investigations of commercial fish sticks and of experimentally-prepared sticks have been made, including studies of frozen storage of samples. Factors affecting the consumer acceptability of fish sticks have been evaluated and standard descriptive procedures for the grading of the sticks were prepared. Close cooperation with the National Fisheries Institute Fish Stick Committee has been maintained in all of the research conducted. A contract was signed during September 1954 with the National Fisheries Institute to establish industry liaison for Federal-industry joint development and application of the standards.

The Fish Stick Subcommittee has participated with the Service's Technological Section in a joint development of a draft of Proposed Voluntary Standards of Frozen Fried Fish Sticks. The samples of fish sticks collected for the N.F.I. convention product-evaluation session have been graded by technical representatives of industry and Fish and Wildlife Service fishery technological personnel in the East Boston Laboratory, according to the proposed voluntary standards procedures. The proposed voluntary Federal standards have been sent to interested persons of the fish-stick industry for their written comments and suggestions.

Meanwhile, staffs of the Boston and Seattle fishery technological laboratories are continuing to accumulate data and information needed for application of the proposed standards for frozen-prefried breaded fish sticks. They are testing in practice the grading procedures for assessing the quality of the fish sticks. Investigations are also under way to develop objective tests of quality which will supplement the subjective tests in the standard.

The staff of the College Park Laboratory will conduct bacteriological studies and biochemical tests of factors which effect quality of fishery products. It is also coordinating all of the standardization activities of the Service's laboratories and industry, and will maintain liaison with other governmental agencies which have food standardization, inspection, and grading services.

The Service has awarded two research contracts which will be applicable to our standards program. The University of Washington will evaluate the principal tests for freshness in fishery products. The investigation will determine the value of such tests as volatile acids, volatile-reducing substances, trimethylamine, and hydrogen sulfide as indexes of quality. The Massachusetts Institute of Technology will endeavor to develop new objective tests for freshness of fish.

Standardization results from the desire and need of the industry for uniform measures of important variations in quality. The producer desires to get the price that the quality of his product and the condition of the market entitle him. The processor and distributor need the quality grades to facilitate buying and selling. Since the first objective is widest possible uniformity in standardization work, the lead must be taken by the Federal Government. Industry can cooperate by supplying the Federal Government with all the facts concerning the varied condition and practices throughout the producing areas and in the trade in order that they may be evaluated and considered in the development of realistic and practical voluntary standards. The Government standardization agency seeks the advice of producers, processors, distributors, and consumers. It obtains their suggestions and comments in order to reach a complete understanding between the persons involved.

While there are no voluntary Government standards for fishery products, the procedures for the issuance of standards and regulations governing the grading and inspection of them, and the services rendered, are generally those presently in effect for the various commodities, such as poultry. The procedures contemplated are as follows:

The industry shows interest and makes inquiries, and demands voluntary standards. Informal meetings and discussions of views are held, to obtain the over-all picture. Such meetings have been conducted by the Fish Stick Committee of the National Fisheries Institute.

The Federal Government then drafts the proposed standard or regulation, and publishes it, in accordance with the provisions of the Administrative Procedures Act, in the Federal Register, under the title of "Notice of Proposed Rule Making."

A mailing list of interested persons is prepared and letters are sent out requesting written views and arguments regarding the proposed voluntary standard. Industry may present suggestions for changes in the proposed rules, if it wishes.

The suggestions and views are considered by the Administrator and experts of his staff, and certain revisions may be made.

Then a final rule is issued, and the proposed voluntary standards are promulgated in the Federal Register, and become official.

Once the standards are put into effect, any interested person can benefit from their use. Fishermen can use the standards. The quality-conscious packer or processor demands fresh fish of high quality and is willing to pay more for them. A better return for a lesser amount of high-quality fresh fish may be received than for a bigger amount of low-quality fish.

Processors may use the voluntary standards as a basis for contracting with buyers and as a guide to improve packing operations. They may be an aid in financing their operations, and in meeting the ever-increasing demand for foods packed according to definite grade standards.

Distributors can use grade standards to select, for their trade, the grade and factors desired in the contract of purchase. They can maintain uniformity of quality under their brands. Grade information may be carried on their labels for the benefit of consumers, if continuous in-plant inspection has been made by Federal inspectors applying the appropriate grade standards.

Institutional buyers may use the grade standards to fit their purchases to the use for which intended. They may find the standards very useful in drafting specifications to meet their needs, or use the standards as buying specifications.

There are three types of grading and inspection services available:

1. Grading of fresh or chilled fishery products at terminal markets and other points;
2. Grading of processed and manufactured fishery products in official plants, at terminal markets, and other receiving points;
3. Inspection of fishery products in official plants for processing.

Grading service shall be for class, quality, quantity, or condition, and shall be on the basis of United States voluntary standards and grades. However, grading service may be rendered with respect to products bought and sold on the basis of contract specifications. Grading may be on a continuous basis or a seasonal basis.

Inspection service shall be for the determination of the condition, wholesomeness, and fitness for human food of fishery products.

Grading and inspection certificates will be issued covering products graded and inspected and such certificates shall show the class or classes of fishery products,

the quantity contained in the respective lot, and all pertinent information concerning quality, quantity, or condition of the products.

There are two types of grade and inspection marks used to label products. One carries the legend of the U. S. grade of the product and the other contains a statement "Processed and packed under continuous inspection of the Department," in addition to the U. S. grade mark.

The grade labeling must be checked and approved by the Government grading agency, to be sure that there is no misrepresentation as to the contents of the labeled product.

Inspection and grading certificates are documentary evidence of quality and condition to accompany warehouse receipts in financing operations; as proof of quality and condition to accompany sales offers, invoices, and shipping documents; to substantiate quality and condition of deliveries; and as a basis for labeling retail containers. The final certificates are admissible in all courts of the United States as prima facie evidence of the truth of the statements they contain. Applicants who may request inspections are food processors, bankers, brokers, wholesale distributors, retail grocers, warehousing concerns, railroad agencies, and Federal, State, and city purchasing agencies.

Continuous inspection regulations require that a Government inspector be stationed continuously at the processing plant to observe the product from its raw state through every step in the entire process, and to make an inspection of the finished product for quality and condition. The inspector makes certain that the products are prepared and packed under strict standards of cleanliness.

All of the types of inspection and grading services are on a fee basis sufficient only to cover the cost of the services, and are paid to the Government.

--Arthur J. Nolte, Fishery Products Technologist,
Fishery Technological Laboratory,
Branch of Commercial Fisheries,
U.S. Fish & Wildlife Service, College Park, Md.

LITERATURE REVIEW OF FACTORS THAT MAY AFFECT PROCESSED FEEDS QUALITY

A literature review of the factors that may affect the quality of processed feeds is now being compiled at the Service's Seattle Fishery Technological Laboratory. This review was undertaken to obtain information that will aid in the development of methods of chemical analysis that will indicate the nutritive value of fish meal.

Based on the present knowledge, none of the component substances in fish meal can be used as a criterion of the nutritive value. It is also not possible to state what effect the various processes used in fish-meal production will have on either the component substances or the over-all nutritive value of the meal.

Thus, before laboratory tests can be developed, information must be obtained as to (1) which of the constituent substances contribute most to the nutritive value of the meal, (2) what is the relationship among them, (3) what effect a change in any one constituent will have on the over-all nutritive value, and (4) what causes these changes in the constituents.

Many workers have studied various aspects of this problem. Consequently, information from these studies is being accumulated, evaluated, and systematized so that the information relative to the various aspects of the problem will be easily available. Furthermore, since the problem is not unique to the fishing industry but exists for the producers of all types of processed feeds, pertinent information concerning other protein feeds is also being included.

Abstract journals being used in the compilation of the review include Chemical Abstracts, starting with volume 21 (1927); Biological Abstracts, starting with volume 1 (1926); Commercial Fisheries Abstracts, starting with volume 1 (1948); and and Food Science Abstracts, starting with volume 22 (1950). In addition, a number of periodicals are being thoroughly covered that were not included by the abstract journals or that were used most often for the publication of articles applying to the various phases of the problem.

The review is divided into 13 parts, and each one of these is further divided into a first section called "Summary," a second section called "Fishery Products," and a third section called "Nonfishery Products."

In each part the summary section gives a general discussion of the abstracts appearing in that part, points out any contradictions among the abstracts, and briefly states some of the problems remaining to be solved.

The topics covered in the review are as follows:

I. Factors that affect the over-all nutritive value of the product
II. Factors that affect the digestibility of the product
III. Effect of raw material on the quality of the product
IV. Protein and its relation to the quality of the product
V. Amino acids and their relation to the biological and nutritive value of the product
VI. Fats, fatty acids, and their relation to the quality of the product
VII. Effect of processing methods on the quality of the product
VIII. Effect of storage on the quality of the product
IX. Keeping quality of the product
X. Biological methods for determining nutritive value and quality of the product
XI. Other analytical determinations
XII. Review articles applying to the problem
XIII. Correlation of methods for determining nutritive value or quality of a product

Resumes of approximately 300 articles have already been prepared; and about 100 more will be abstracted later.

Parts I through IV and Parts VI and VII have been prepared and duplicated. Any articles among those yet to abstracted that are applicable to these parts will be added later. The remaining parts are being compiled at the rate of about one part per week.

The following are the summaries for the parts that have now been completed:

PART I - FACTORS THAT AFFECT THE OVER-ALL NUTRITIVE VALUE OF A PRODUCT

A section on the nutritive value of processed materials is almost redundant. Nearly all of the papers on protein, amino acids, fat, raw material, processing, and storage are applicable in a section dealing with nutritive value. Obviously, it is both undesirable and unnecessary to repeat all of these abstracts in this section. Thus, in most instances, the articles included in Part I deal with generalities or give the results of determinations of the nutritive value of various products.

The vitamin content of a product has an important bearing on its nutritive value. For this reason the effects of processing conditions on the vitamin content of meal and solubles are also included in this section. Riboflavin and vitamin B_{12} are often used to check the vitamin content or a change in the vitamin content due to some variation in the treatment or source of a product. The vitamin B_{12} content of fishery products changes during spoilage. A relationship has been shown between the loss of these vitamins and pH, time, and temperature during processing.

Folic-acid deficiency has been shown to result in poor growth, poor feathering, and a high incidence of perosis in chicks. Inositol plus vitamin E have prevented hock disorder.

The problems of variations in and measurement of nutritive value of a product are not unique to fishery products. Producers of all types of processed feeds are interested in finding ways to make a standard product and laboratory methods to measure the value of a product.

PART II - FACTORS THAT AFFECT THE DIGESTIBILITY OF THE PRODUCT

The digestibility of a product can be affected by both physical and chemical factors. Thus, Part II, on the whole, includes generalized articles that mention the various points that may affect digestibility.

The measurement of digestibility is a problem. The animal used will affect the results and standardizing conditions are often difficult. The digestibility of various feeds have been measured by both in vivo and in vitro methods. Unfortunately, complex animal organisms react differently than enzymatic systems and the in vivo methods do not give the same results as in vitro methods. This indicates that digestability and nutritive value of a feed are not directly related to chemical composition.

PART III - EFFECT OF RAW MATERIAL ON THE QUALITY OF THE PRODUCT

Almost no information is available to determine the effect of raw material on the quality of a meal. There are reports in the literature that compare meals made from different fish, but the meals have not been processed under definite enough conditions to provide definite proof that meals from different species are different. At this stage of our knowledge such facts as whether part or all of the fish is used, the condition of the fish, and the processing are probably more important than the species of the fish.

The condition of the fish may influence both the amino acid and vitamin content of both the meal and stickwater. It has been stated that spoilage of the raw material is accompanied by a change and general decrease in the amino acid content.

A few studies have been done on the effect of storage and preservation of the raw material on the final product. Two groups of workers have stated that storage

of raw fish did not affect the nutritive value of the meal. However, the yield decreased rapidly. The oil content of the fish did not change, but the free fatty acid and color of the oil increased, and the meal contained increasing amounts of oil, thus reducing the free oil recovered. The yield of condensed fish solubles increased, but the nutritive quality deteriorated. For fish stored from 4 to 10 days at 45° F., there were rapid increases in free fatty acids, volatile nitrogen, and loss of protein in the stickwater.

The Norwegians tested the effect of preservatives on the raw fish to be used to make meal and stickwater. They advised that volatile preservatives are advantageous to avoid high concentrations in the stickwater or meal. Nitrite brine and formalin brine were effective. In some experiments the formalin brine was better, but, if open containers were used, the nitrite brine was better. Formalin appeared to be more effective in preventing the decomposition of fat, and nitrite in preventing the decomposition of protein.

The Norwegians have also reported that the stomach contents of summer herring affected the cooking and pressing, and lowered the nutritive quality of the meal. The actual effect on the nutritive value of the finished meal of the feed the fish have been consuming is difficult to check and certainly is a phase that can be postponed until more basic work is done.

However, the effect of the general condition of the fish or waste material is basic and can be determined. The principal difficulty involved in this is that different types of spoilage may have different effects on the finished meal. Thus the conditions of spoilage must be carefully controlled to limit the number of unknown variables to a minimum.

PART IV - PROTEIN AND ITS RELATION TO THE QUALITY OF THE PRODUCT

Protein is among the most important constituents of fish meal, not only from a nutritive standpoint, but also because the cost of a fish meal is based on its protein content. As a result, quite often when experimental work has been started on the nutritional value of fish meal, the protein is the part that has been studied. However, measurement of the nutritional value of protein is difficult, time-consuming, and expensive, whether it be in fish meal, cereals, or a pure protein. At present, the most reliable methods are biological assays using chicks or rats. A number of chemical laboratory methods have been attempted, but none of them has been very successful in getting the same results as that obtained by biological methods.

One of the earlier chemical methods developed was that known as the protein-quality index. This method was developed with the recognition that total protein values alone do not give an accurate indication of the value of protein. To measure the protein-quality index the following protein fractions are determined: copper-precipitated protein, which is intact protein and which decreases as decomposition increases; phosphotungstic acid precipitated protein, which consists of peptones, peptides, and amino acids not precipitated by copper; the crude protein not digested by pepsin, which consists of keratins, denatured proteins, and certain insoluble nitrogen compounds; hot-water-soluble protein, which consists mainly of gelatin. The protein-quality index is the sum of copper-precipitated protein minus the undigestible protein minus 0.6 times the hot-water-soluble protein plus 0.4 times the phosphotungstic-acid precipitate times 100 divided by the total crude protein. This method of protein-quality index was used in one instance to explain why dogfish meals prepared by a wet process had a higher nutritional value than those prepared by a dry process. The dry-process meal contained 8.9 percent more total protein than the wet-process meal. However, the nutritive value of the meal was lower because more decomposition occurred in the dry-process meal and much of the protein went to the amino acid stage or further. A number of analyses of fish meals for protein-

quality index have been reported, although the determination is time-consuming and its correlation with biological value is still in doubt.

Among other laboratory methods used to estimate the value of various protein feeds are the use of enzymatic digestion and acid hydrolysis followed by amino-acid analysis; the rate of liberation of amino acids from the protein by enzymes; the use of dyes to measure quantitatively the acidic and basic groups of protein molecules; microbiological determinations using Tetrahymena geleii W. At present these methods do not give enough information so that they can be substituted for biological methods to determine the nutritional value of protein.

One of the most important phases of the problem of the nutritive value of protein is the effect of processing procedures. There are many reports in the literature on the stages of processing and their effects on fish meal and on other protein feeds. Much of the early work on processing was done when there was very limited knowledge about vitamins and must be evaluated with this fact in mind.

Some of this work on the effect of processing on the nutritive value of fish meals indicated that high temperatures decreased digestibility, biological value, amino-acid content, protein efficiency, and riboflavin. However, it is still difficult to determine whether other factors involved have as much or more effect than the temperature.

Probably the feed material that has had the most study on methods of proper processing is soy protein. Studies of soybean meal have shown that for different reasons both underheating and overheating will affect the nutritive value of the meal. If the meal is underheated, a trypsin inhibitor is not destroyed and the result is poor utilization of the protein. This factor is of no importance in fish-meal production. If the soybean meal is overheated, digestibility and nutritive value decrease.

One of the important factors in heat damage to protein is the Maillard reaction in which the aldehyde group of carbohydrates apparently reacts with amino groups in the protein or amino acid. Although fish meal contains almost no carbohydrate, there is still a possibility that this type of reaction may occur with other aldehydes during processing.

Among processing factors that may affect the nutritive value of the product are: whether the meal is wet-rendered or dry-rendered, the press, the condition of the raw material during drying, and how long the meal may be subjected to a high heat when the drying is almost completed. The effects of storage and the importance of the conditions of storage on the nutritive value of the protein are other factors that may play a part in determining the over-all nutritive value of the meal.

Many of the factors that determine the nutritive value of protein and the importance of various interrelationships are still among the problems to be solved. However, knowledge is increasing, particularly about the amino acids. Enough work has been done on amino acids that is relative to the problem of the quality of fish meal that they will be discussed as a separate subject in Part V (to be released later).

PART VI - FATS, FATTY ACIDS, AND THEIR RELATION TO THE QUALITY OF THE PRODUCT

Many fish meals are prepared from raw materials with a high oil content and a high degree of unsaturation in the oil. Although most of the oil is often removed before the meals are processed, that still present will change during both processing and storage of the meal.

Numerous short-term investigations have been carried out looking into the effect of the condition of oil present in mixed feeds either as the natural oil occurring in fish meal or as added oil. No really comprehensive investigations have been made. Results of what work has been done are often conflicting so that no firm conclusions can be drawn. Following are some of the principal results reported in the literature.

It has been demonstrated that the composition of oil was altered during manufacture of fish meal. The amount of total fatty acids in cold-pressed menhaden oil was much higher than in oil extracted from menhaden meal. In addition there was a lower percentage of saturated fatty acids and a higher iodine number for the unsaturated acids present in the cold-pressed oil. Some work on Norwegian herring was reported in which the fat in the press cake had a higher free fatty-acid content than the pressed oil. Fat in the press cake was clear and easier to extract than the dark fat extracted from the fish meal. In one instance it was suggested that an indication of quality might be obtained from the free fatty-acid content, which is normally about 5 percent of the fat but has been as high as 40 percent in samples with much decomposition. However, whether free fatty-acid content can be used as a criterion of nutritive value is still unknown, although several workers have indicated that the fatty acids may be one of the factors involved.

The reasons for losses of nutritive value for chicks and rats during processing of fish meal have been investigated in experiments where the meals were prepared under controlled conditions. Canadian workers have heated extracted and nonextracted herring meals at 300° F. for 0, 60, 120, and 180 minutes. When these meals were fed to chicks, both of the meals heated for 180 minutes and the unextracted meals heated for 120 minutes caused lowered growth. When the oil was extracted and added to the heated extracted meals that had not lowered growth, the nutritive value for chick growth was decreased. Fresh herring oil did not have this effect.

In the period immediately after the fish meal leaves the drier, the meal begins to heat spontaneously. The temperature of the meal has been shown to increase as much as 125 Fahrenheit degrees in the first 10 to 20 hours after drying. Factors that affect the time and duration of the heating period include the type of meal, fat content, amount of unsaturation of the fat, and moisture content. Peroxide values of extracted fat increased very rapidly during the first 24 hours after processing.

The ether-soluble fractions decrease during storage and one worker has reported that the largest decrease in herring meals was in those that had become most rancid during the drying process. Japanese workers also have reported this decrease in the ether-soluble fraction during storage. The iodine and bromine values decreased and there was little increase in the free fatty acids. None of these results were compared with the results of animal-feeding tests, so that the actual effect on nutritive value is unknown.

In much of the work that has been done on the effect of fat on the nutritive value of products other than fish meals, rats have been the test animals. However, when animal protein concentrates were tested using chicks, it was reported that a high free fatty acid content of the fat was not an indication of the nutritive worth of such products in well-balanced rations for poultry feeding. High rancidity of the fat in the concentrates did not greatly effect the nutritive value when the concentrates were used at 10- to 15-percent levels in the feeds. Other reports have indicated that rancid or oxidized fat fed to rats had lowered nutritive value.

Grains change during storage periods. Free fatty acids and peroxide values increase, the nitrogen soluble in 3 percent sodium chloride decreases, but again the importance of the changes in nutritive values were not checked by animal tests.

It is obvious that the effects of fat, its kind, degree of unsaturation, extent of rancidity, and other changes that may take place in the fat are factors that require additional study to determine their importance in affecting nutritive value and quality of the product. Such knowledge would also help to determine the processing steps necessary to avoid deleterious changes. Particularly needed are more systematic investigations into the nature of the changes which take place in the oils in fish meals during the heating which occurs immediately after manufacture. This heating probably results in the formation of oxidative oil compounds. There is some evidence that these compounds may have a toxic effect. The oils may also combine in some manner with amino acids or proteins, making them less digestible or unavailable to animals; or alternatively, the heating of the oils in the fish meal during curing or storage may, through production of high temperatures, cause alteration or breakdown of amino acids and proteins. While there are hints in the literature that such reactions may take place, no comprehensive investigation to determine just what takes place during this stage of oxidation of fish oils in meals has been made. Such investigations would do much to clarify the nutritional role of fat in fish meal and might result in revealing one of the principal causes of the wide variability in the nutritive value of different fish meals.

PART VII - EFFECT OF PROCESSING METHODS ON THE QUALITY OF THE PRODUCT

In general, research on the effect of processing methods on the quality and nutritive value of fish meal has not been directed to find the basic reason for variations that appear. A survey of the literature shows lack of agreement about the effects of processing methods and the reasons for these effects. Many of the studies that have been reported were done when methods were not available to analyze and when there was little or no knowledge of vitamins, particularly of members of the vitamin B complex. Thus, it is necessary to examine the results of various feeding tests with the thought in mind that when one product was said to be inferior to another, the cause might have been a vitamin or amino-acid deficiency. Considerable stress should be given this factor in the use of the abstracts summarized in this report.

Experiments have usually been conducted on the biological value or digestibility of the meal, and the results are conflicting. Undoubtedly one reason for this is given in a Norwegian paper that states the effect of a drying method can only be determined if meal from the same raw material is prepared simultaneously in different driers. Results at this laboratory are among those that have indicated that there was no great damage to the protein caused by unfavorable drying conditions. However, other reports state that direct heat-dried meals are inferior to vacuum-dried or steam-dried meals. It has also been reported that a greater difference in nutritive value exists between meals from the same species prepared by a different process than between meals from different species prepared by the same process.

Recently two laboratories have reported the effects of processing methods on fish oils. Decreased growth of both chicks and rats resulted when fish oil was heated at 300° F. for 2 hours or was polymerized at 275° C.

Attempts have also been made to check the effect of processing on individual amino acids in fish meals.

Problems of processing protein meals are not peculiar to fishery byproducts. Heat has been shown to damage protein under a variety of conditions, sometimes at temperatures lower than is required for destruction of amino acids. Dry heat, wet heat, the presence of reducing sugars, length of time of processing, temperature of processing, and method of drying are among the factors in processing that have been shown to affect the quality of a product. Soybean meal must be heated at an optimum temperature. If the meal is underheated, a trypsin inhibitor is not destroyed; if the meal is overheated, damage to the protein results. In either case the nutritive value of the meal is decreased.

Experiments on cereal products have sometimes indicated that dry heat is less damaging than wet heat, but in other instances the reverse has been recommended. The factors that change digestibility or availability of amino acids in a product are often the factors that must be determined.

On the protein quality of cottonseed meal recent workers found that a low processing temperature did not always produce high-quality meals. Others have reported that protein efficiency varied with the amount of heat treatment. It has been recommended that cottonseed meal be cooked at a low temperature for a longer time rather than at a higher temperature for a shorter time.

So many factors can cause variations in the nutritive value of a product that one must eliminate as many variables as possible to determine both what factors cause damage and what kind of damage is the most harmful to the quality of the meal. Much of the experimental work has been of the type that has determined the biological value of a particular meal, but has contributed nothing to the reason for this effect, even though at least part of the history of the meal was known. Experiments to determine the fundamental effect of processing still remain to be carried out and this basic work can best be done by working with one variable at a time. When it is known what factors influence quality and how these factors are affected by the stages of processing, then additive results of the damage can be determined. At present, it is still almost impossible to make a meal of good or poor quality at will except for scorching the protein which always reduced its nutritive quality. When variations can be made within reasonable levels basic causes for an inferior meal will have been found and the answers to processing problems will no longer be elusive.

Parts VI and VIII thru XIII of this literature review will be summarized in a subsequent report.

--Neva L. Karrick, Chemist
Fishery Technological Laboratory
Branch of Commercial Fisheries,
U. S. Fish and Wildlife Service, Seattle, Wash.

FEDERAL SPECIFICATIONS FOR FRESH AND FROZEN FISH ISSUED

Federal specifications for fresh and frozen fish, PP-F-381d (September 3, 1954), was recently issued by the General Services Administration. This supersedes Interim Federal Specification PP-F-00381c and Federal Specification PP-F-381c.

Special commodity clauses for waterfoods, clams, and shrimp, covering Defense Department purchases, were also issued recently by the Army Quartermaster Market Center System.

The above specifications and special clauses are effective May 20, 1955, and copies may be obtained without charge from the General Services Administration Regional Offices in Boston, New York, Atlanta, Chicago, Kansas City (Mo.), Dallas, Denver, San Francisco, Los Angeles, Seattle, and Washington, D. C.