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## PROGRESS ON TECHNOLOGICAL RESEARCH PROJECTS OF THE SERVICE'S BRANCH OF COMMERCIAL FISHERIES, 1951-52

A discussion of the Fishery Technological Research Program appeared in the November 1951 Supplement of Commercial Fisheries Review, vol. 13, no. 11a, pp. 2-7 (also reprinted as Separate 294). A review of the progress made in each project during the fiscal year 1952 (July 1, 1951-June 30, 1952) follows:

### NUTRITION

1. Investigation of the toughening of frozen blue-crab meat. Experimental work was conducted the previous year to determine if enzymes are involved in the change of texture of frozen crab meat. Some preliminary work was done to identify the enzyme or enzymes present in crab meat. This year, work on this project was stopped temporarily because no one was available to continue the research.

2. Feeding studies with gums extracted from Irish moss. Gums are being extracted from Irish moss and derivatives of these are being used in foods and pharmaceutical preparations. Rats and mice have been allotted to 5 comparable groups and fed a balanced ration to which has been added 0, 1, 5, 15, and 25 percent of the gum. The animals have now been on experiment from about 1 to 1½ years and will be kept on experiment until death. The data to the present time indicate that the product is wholesome.

3. Chemical and physical properties of fish and shellfish proteins. A fundamental study of water retentivity in meat of fish, with particular reference to the mechanism of drip formation in frozen fish, is being made. It was found that drip formed maximally at the time that the last vestige of frost disappeared. More drip was formed in thawing at high temperature than at low. Spoiled fish yielded more drip than did fresh fish. The amount of drip varied for different species of fish. Less drip resulted from fast freezing than from slow freezing. The initial effect of freezing rate of the fish on the amount of drip was nullified on subsequent storage of the frozen fish. The foregoing findings for fish applied also to oysters. Passing fresh fish through a food chopper having ½-inch holes reduced the water retentivity, or produced the same amount of drip as did freezing the fish.

4. Thiaminase content of certain species of fish used in feeding fur animals. Thiaminase, an enzyme occurring in some fish, destroys the vitamin thiamine. When this enzyme is present in high concentration in the diet, it causes a nutritional polyneuritis known as Chastek paralysis. Since large quantities of raw fish waste are used for feeding fur animals, the level of thiaminase activity in several samples of fish waste was determined. These samples included Alaskan salmon waste, and true cod, rockfish, and sole filleting waste. In the samples so far examined the level of thiaminase activity is very low.

5. A study to determine the comparative hemopoietic value of fish. The previous year a metabolism study was conducted with the cooperation of the College of Home Economics of the University of Maryland. A group of 8 girls consumed a basal diet low in protein but adequate in vitamins, minerals, and calories. Four

girls received an additional allowance of protein in the form of fish, and the other four girls received theirs in the form of beef or veal. During a 6-week test period, there was no difference between the two groups in the composition of weekly samples of venous blood or the efficiency in which the protein of the fish or meat was utilized. Selected food samples are now being analyzed to determine how published values compare with actual values for iron, calories, and vitamin B<sub>12</sub> of the foods used. This work will continue into the coming year.

## REFRIGERATION

### 1. Freezing fish at sea, defrosting, filleting, and refreezing the fillets.

#### a. OVERHAUL OF THE RESEARCH TRAWLER DELAWARE AND THE FISHING OPERATIONS:

The Delaware was completely overhauled and placed in good operating condition. Some of the major items completed were: thorough overhaul of the main engine and propulsion equipment; replacement of the trawl-winch Diesel engine, the towing gear, and the batteries; installation of echo-sounding equipment; and renovation of the crew's quarters.

The fishing and deck gear were thoroughly tested during the cruises completed. Minor changes and adjustments were made as required. Fishing was conducted in the Georges Bank area to supply fish for other phases of the project.



ABOARD THE RESEARCH TRAWLER DELAWARE. HANDLING FISH FOR THE FREEZING-FISH-AT-SEA PROJECT.

#### b. FREEZING AND STORING FISH ABOARD VESSEL: The refrigeration machinery, the brine-freezer system, and the refrigerated storage system (newly installed aboard the vessel) were tested in use under at-sea operating conditions. Based on this experience and observations, extensive alterations and improvements were made. A second refrigerated storage room, operating at 0° to 5° F., was installed in the fish hold.

Numerous lots of fish in the several size and species categories common to the New England banks were frozen in brine, stored aboard ship, and returned to the laboratory for continuance of the project's research.

#### c. DEFROSTING, FILLETING, AND PACKING OF FISH ASHORE: The round frozen fish from the Delaware were used to further test, on a large scale, the equipment and techniques developed in the pilot-plant ashore. The information thus obtained was prepared for use in recommending equipment and procedures for the thawing of round frozen fish by commercial concerns.

Several 1,000-pound lots of round brine-frozen fish were thawed in the pilot-plant equipment, filleted, and packaged by a commercial concern. The fillets were placed in a commercial cold storage for comparison at biweekly intervals over a six-month period, with fillets from iced, gutted fish similarly stored.

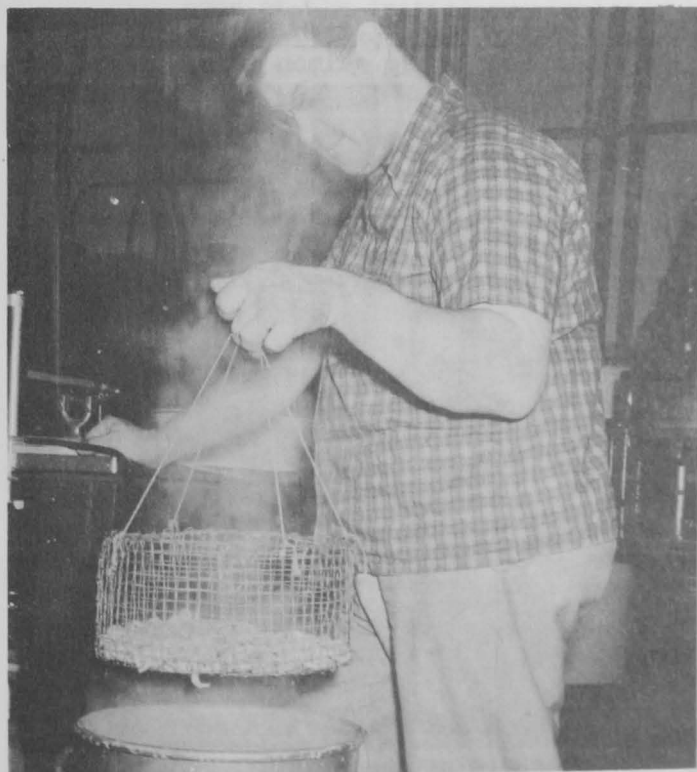
d. TASTE PANEL AND CHEMICAL TESTING OF FISH IN THE LABORATORY: Early in the project the laboratory staff tested round brine-frozen fish prepared aboard the Delaware from the standpoint of salt penetration. These tests showed that when brine freezing was accomplished within the normal expected operating temperature range for the Delaware, and when these frozen fish were thawed in fresh water, the residual salt content of the fillets was no more than that of fillets from iced, gutted fish.

The taste panel, to pass upon the palatability of the fish fillets prepared on the project, was set up and trained. Taste-panel tests are being used:

- (1) To establish the normal palatability level of commercially-prepared frozen and fresh fillets obtained at random on the local retail market;
- (2) To assist in the establishment of an optimum fillet-brining procedure; and
- (3) To evaluate the series of stored frozen fillets for possible changes that may develop during their normal storage life.

Procedures for physical and chemical evaluation of the quality and other allied characteristics of fish products were tested for use as supplements to the taste-panel observations.

Results of tests on frozen fillets after about six months in storage indicate that no significant differences have developed in the fillets from round brine-frozen fish as compared to those from iced, gutted fish.



PRECOOKING ALASKA SHRIMP MEATS IN BRINE FOR STUDIES ON FREEZING AND STORING ALASKA SHRIMP.

In anticipation of improvements in the operation at sea, extensive testing has been conducted by the laboratory to develop freezing solutions or media both adaptable to temperatures in the  $-10^{\circ}$  to  $-20^{\circ}$  F. range and otherwise satisfactory for the freezing of round fish in existing vessel equipment.

2. Freezing and storing Alaska shrimp and dungeness crab. Preliminary work during 1950-51 indicated that development of adverse flavor and texture changes in frozen shrimp was affected by the methods of preparation of the shrimp for freezing. A series of sample packs of frozen Alaska shrimp were prepared early in 1952 using various processing and packaging procedures.



3. Preparation of a manual on the refrigeration of fish. Two chapters of the manual on the refrigeration of fish have been completed and are ready for review and editing.

4. The effect of storage conditions on quality of frozen fish. Frozen whole fish, stored in refrigerated rooms provided with unit coolers employing blowers for circulation of air, will lose their protective ice glaze rapidly. The glaze protects the fish from dehydration and also delays the development of rancidity, particularly in the fatty fish. Tests with frozen glazed whole salmon using pilot-plant refrigerated storage (0° F.) facilities indicated that unprotected frozen salmon lost most of the ice-glaze after 4 weeks of storage, but salmon wrapped in heavy kraft paper or placed in fibre boxes lost most of the glaze only after 20 weeks of storage. Results to date on further tests in progress indicate that glazed frozen whole salmon wrapped in heavy waxed paper or in polyethylene bags lost no appreciable amount of ice-glaze after 6 months of storage at 0° F.

5. Study of cause of texture change of canned salmon prepared from frozen fish. Previous experiments indicated that freezing salmon prior to canning produces adverse changes in the final products. These changes are (1) toughening of the canned product, (2) excessive curd formation, and (3) absence of free oil. Further tests indicated that the length of frozen storage prior to canning is directly correlated to the adverse texture changes. Apparently, freezing salmon without subsequent storage causes no major texture change in the canned product, but subsequent storage induced toughening of the canned product.

It has been shown that brining can-sized chunks of the thawed salmon substantially reduces curd formation in the canned product.

## PROCESSING AND PRESERVATION

1. Development of specialty food products from Alaska fish and edible fish trimmings. Several test-canned packs of plain and smoked salmon eggs, smoked herring, smoked clams, and smoked shrimp were prepared. Use was made of the newly-constructed controlled smokehouse installed at the Ketchikan laboratory. Several products showed definite promise as commercial canned specialty fish items.

## ANALYSIS AND COMPOSITION

1. Chemical composition of fish: (1) Menhaden. An extensive review of the literature was made during the early part of the year in order to determine what chemical or pharmaceutical preparations had been reported to have been made from fishery products. A report entitled "Chemistry of Menhaden" was published in the November 1951 Technological



PREPARING HERRING FOR SMOKING IN THE NEWLY-CONSTRUCTED CONTROLLED SMOKEHOUSE AT THE KETCHIKAN FISHERY PRODUCTS LABORATORY. PURPOSE WAS TO DEVELOP SPECIALTY FOOD PRODUCTS FROM ALASKA FISH.

Supplement to Commercial Fisheries Review. Two articles dealing with products from menhaden were prepared and published in trade journals. Experimental work on this project is now held in abeyance in favor of working on the production of dried menhaden solubles.

2. Cooperative work with the Association of Official Agricultural Chemists. This project was set up on a part-time basis and work was scheduled for May, June, and July of 1952.

3. Composition and cold-storage life of fresh-water fish.

- a. COMPOSITION: The proximate composition (moisture, oil, protein, and ash) of the edible portion and the fillet yield of 16 individual fish of 6 species (blue pike, yellow pike, yellow perch, whitefish, sheepshead, and smelt) were determined. The whitefish had a high oil content and showed considerable variation in the oil content from one fish to another. Sheepshead had a moderate amount of oil and showed some variation from one fish to another. The smelt had a low oil content and showed only small variation from fish to fish. All other species were relatively non-oily. Other components for all fish were fairly consistent.
- b. COLD-STORAGE LIFE: Samples of the frozen fresh-water fish were also placed in cold storage to determine their keeping qualities at 0° F. Blue pike, yellow pike, and yellow perch showed no significant deterioration in quality after 6 months of storage. The frozen sheepshead were somewhat rancid on receipt at the laboratory. Subsequent storage of these fish showed only a slight decrease in quality after 6 months. The whitefish were quite soft on thawing and were difficult to fillet even at the initial examination; however, the cooked samples were rated good in flavor and texture. After 3 months of storage of the whitefish, there was no detectable change in quality. Samples of Lake Michigan smelt and Columbia River smelt have been recently included in the tests.

#### BYPRODUCTS

1. Vitamin content and nutritive value of fishery byproducts.

- a. COMPOSITION: Microbiological assays: Series of samples (raw fish, fish from the cooker, press cake, foots from the press, stickwater, and meal) from three byproducts companies were analyzed for vitamin, oil, and moisture content. Vitamin assays were made for riboflavin, niacin, and vitamin B<sub>12</sub>. High concentrations for all these vitamins were found in the stickwater. There was little or no loss of the vitamins in the preparation of the meal from the press cake. Solvent extraction of raw fish resulted in a definite loss of niacin and some decrease in vitamin B<sub>12</sub> in the final meal. Analyses of 8 visceral organs of the sardine showed that the kidney had by far the highest vitamin B<sub>12</sub> content, with the liver ranking second.

Biological assays: A number of assays with chicks have been conducted to determine the vitamin B<sub>12</sub> content of fish meals and fish solubles. The data indicate that the vitamin B<sub>12</sub> content of the meals is fairly uniform. The vitamin B<sub>12</sub> content of the condensed fish solubles seems to vary considerably. All samples which have been assayed have been sent to the Seattle laboratory for microbiological assay. A limited number of assays will be conducted during the coming year.

- b. **EXPERIMENTS ON UNKNOWN GROWTH FACTORS:** Since the discovery of vitamin B<sub>12</sub> there has been a growing interest in other unidentified growth factors. It has been reported by numerous workers that fish are an excellent source of at least one of these factors.



CHICKS USED TO DETERMINE THE VITAMIN B<sub>12</sub> CONTENT OF FISH MEALS AND SOLUBLES AT THE SERVICE'S COLLEGE PARK FISHERY TECHNOLOGICAL LABORATORY.

Experiments on growth factors in fish have been carried out with two objectives in mind: (1) Development of fractionation procedures for concentrating any growth factor; (2) Establishment of a microbiological assay for the fish factor which would circumvent the long, laborious chick assay.

- c. **NUTRITIVE VALUE OF PROTEIN:** A limited number of meals and condensed fish solubles have been fed to chicks to determine the nutritive value of the protein. Quite variable results have been obtained which cannot at the present time be correlated with known differences in raw materials or processing methods used. Further tests are contemplated during the coming year in order to determine reason for variable results.

2. Utilization of viscera from round (whole) fish frozen at sea. No work was done on this project. Work will be initiated as large quantities of materials become available from the freezing-fish-at-sea operations of the Delaware.

3. Study of pharmaceutical and other industrial products from salmon eggs. As an initial step in the characterization of salmon egg protein, analyses of the "essential" amino acid composition by microbiological assay methods are presently being carried out. The work to date on lipid-free protein preparations, from samples of mature pink salmon (Oncorhynchus gorboscha) eggs, reveals that the protein of the eggs from mature salmon of this species is a very good source of all of the ten essential amino acids.

4. The development of a dried product from condensed menhaden solubles or stickwater. During the late summer of the previous year work was begun on this project on the recommendation of members of the menhaden industry. Most of the time has been spent on making dry concentrates of condensed solubles, using fish meal and dry fish scrap as absorbents. Concentrates containing 60 percent of the



dry matter from solubles have been prepared and could be produced commercially with but little change in equipment. Present work deals with producing a dry



TECHNOLOGIST PREPARING CRUCIBLES FOR ASH DETERMINATIONS OF CONDENSED FISH SOLUBLES AT THE SERVICE'S COLLEGE PARK TECHNOLOGICAL LABORATORY.

product without the use of absorbents. Samples of menhaden meal and solubles collected in the field have been analyzed to determine chemical and physical constants and the variations which might be expected. The work on producing dry solubles will be continued during the coming year.

phase 2, economic evaluation of the fisheries adversely affected by industrial pollution, have been completed. Phase 3, summation of the first and second phases, with recommendations and suggestions, was completed by June 30 and the project terminated.

## SANITATION AND BACTERIOLOGY

### 1. Industrial waste pollution study.

Phase 1, an inventory of the current pollution situation, and



## FISH PROCESSING HANDBOOK FOR THE PHILIPPINES

Fish is second only to rice as a food in the Philippines. This handbook, intended for both home and commercial processors of Philippine fishes, covers the handling of fresh fish, the various methods of preserving fish--freezing, salting, drying, smoking, canning, and miscellaneous methods such as pickling--and the spoilage of fish and fish products. It gives a step-by-step description of Philippine fish-preserving methods with suggestions on improving them, and of methods used in other parts of the world which have been adapted for Philippine use by the Philippine Fishery Program of the U. S. Fish and Wildlife Service. Tables of useful data for fish processors and of drawings of common species of Philippine fish are included.

By Arthur C. Avery. Research Report No. 26. Fish and Wildlife Service, Washington, D. C. (1950), 149 pages. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 50 cents.