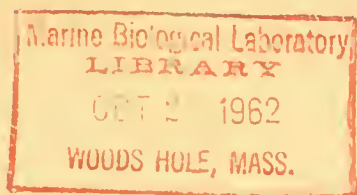


**ANNUAL REPORT of the
GLOUCESTER TECHNOLOGICAL
LABORATORY**

Fiscal Year 1961



UNITED STATES DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

Bureau of Commercial Fisheries

CIRCULAR 139

UNITED STATES DEPARTMENT OF THE INTERIOR, Stewart L. Udall, *Secretary*
FISH AND WILDLIFE SERVICE, Clarence F. Pautzke, *Commissioner*
BUREAU OF COMMERCIAL FISHERIES, Donald L. McKernan, *Director*

**Annual report of the
Technological Laboratory, Gloucester, Massachusetts
for the fiscal year ending June 30, 1961**

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CONTENTS

	Page
Background	1
Research on the chemistry and biochemistry of Fish	1
Protein research	2
Flavor and odor research	2
Composition research	3
Development of standards and specifications	3
Standards development	3
Specifications development	4
Inspection and certification of fishery products	4
Preservation and engineering research	5
Storage of fish in refrigerated sea water	5
Storage and distribution of frozen seafoods	7
Improved solutions for immersion-freezing fish at sea	7
Capacity control system for cold storage rooms	8
Radiation-pasteurization research	8
Publications	9
Laboratory personnel	11

Annual report of the Technological Laboratory, Gloucester, Massachusetts for the fiscal year ending June 30, 1961

BACKGROUND

On June 17, 1960, the Bureau of Commercial Fisheries dedicated a new technological laboratory at Gloucester, Massachusetts. This facility is staffed by 19 professional people trained in the fields of chemistry, food technology, and engineering. These scientists and engineers conduct technological research aimed at solving basic problems of the regional and national fisheries.

The program at the Gloucester laboratory is directed toward (1) improving the quality of seafoods in order to give the consumer the best possible value and at the same time increase and diversify the market for fishery products, (2) improving methods of handling fish to reduce operating costs, and (3) investigating new methods of preservation to enable the processor to level

out production and find new methods of marketing. This program is both fundamental and applied in nature and includes (1) research on the chemistry and biochemistry of fish, (2) development of grade standards and specifications, (3) inspection and certification of fishery products, and (4) studies on the preservation of fish, including the engineering aspects involved. The following is a discussion of the highlights of this program and the accomplishments from July 1, 1960, to June 30, 1961.

RESEARCH ON THE CHEMISTRY AND BIOCHEMISTRY OF FISH

Our studies on the chemistry and biochemistry of fish are of a fundamental nature and are concerned with the denaturation of proteins in frozen fish, isolation and identification of the compounds that cause



Making light-scattering measurements to determine the effect of frozen storage on the size and shape of actomyosin molecules from cod muscle.

the flavor and odor of fishery products, and determination of the chemical and physical composition of fish harvested from specific areas during certain time of the year.

Protein Research

Investigations are being conducted on the molecular structure of fish proteins and on the relation of changes in protein structure to changes in the texture of frozen fish. Knowledge of the physical and chemical characteristics of fish protein will form the basis for developing methods of minimizing changes in quality that now occur during the freezing and extended frozen storage of many species of fish.

Our findings indicate that the stability of fish muscle actomyosin (the major protein

component of the flesh) is greatly influenced by the type of fat in the flesh. Experimental evidence indicates that low concentrations of linoleic and linolenic acids precipitate some actomyosin from solution immediately when fatty acids are added and continue to insolubilize the remaining actomyosin during storage at 39° F. (4° C.). It has also been found that cod flesh soaked in glycerol and stored at 14° F. (-10° C.) for 4 months contains four times as much soluble protein and one fourth as much free fatty acids as does cod flesh treated in the same way but without glycerol.

Flavor and Odor Research

Gas chromatographic and mass spectrometric techniques are being used to isolate and identify those compounds that are



Using the gas chromatograph for the separation of volatile compounds that contribute to the odor and flavor of fresh haddock.

sources of the desirable odors and flavors of fresh fish and the undesirable odors and flavors of stale fish. An understanding of the chemistry of flavor and odor changes may result in the development of methods that will prevent fish from getting "fishy" or make it possible to incorporate a fresh-from-the-sea flavor to many manufactured fishery products.

A new method of programming the temperature of the column of the gas chromatograph has yielded interesting results. Previous experiments using column temperatures of 302° F. (150° C.) enabled only three or four chemical compounds to be separated from the volatiles of haddock flesh. By programming column temperatures from -76° F. (-60° C.) to room temperature, however, it has been possible to detect 18 clearly definable compounds in the volatiles of 8-day-old iced haddock. More extensive studies are planned using a new cooling

and heating system designed to permit automatic programming of the chromatographic column at any temperature between -85° F. (-65° C.) and 176° F. (+80° C.).

Composition Research

Information is being gathered on the protein, oil, mineral, and moisture content of many New England species of fish. This is in addition to physical measurements on fillet yield and size of fish.

Data accumulated on flounder, cod, haddock, ocean perch, mackerel, and other fish are useful in determining effects of various environmental and processing conditions on changes in the chemical and physical components of these fish. Recently, this research was expanded to include amino acid analyses of groundfish and certain shellfish.

TABLE 1.--Average composition data for fillets of flounder, cod, haddock, ocean perch, and mackerel

Species analyzed	Protein	Oil	Ash	Moisture
Flounder:	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Greysole.....	16.2	0.05	1.1	82.2
Yellowtail.....	17.5	0.13	1.3	80.8
Blackback.....	18.8	0.15	1.3	79.9
Dabs.....	17.6	0.23	1.2	80.6
Cod.....	17.9	0.09	1.1	80.9
Haddock.....	18.8	0.17	1.2	79.7
Ocean perch.....	17.9	1.1	1.1	79.3
Mackerel.....	17.3	21.0	1.3	60.0

DEVELOPMENT OF STANDARDS AND SPECIFICATIONS

Another phase of the laboratory research program is the development of grade standards and specifications to facilitate the production and purchasing of fishery products of uniformly high quality.

Standards Development

Grade standards are designed to provide an objective means of measuring and improving the quality of the many diversified seafoods produced in this country. These

standards are voluntarily used by industry and are applied by Fishery Products Inspectors of the U.S. Department of the Interior. Since 1956, standards for seven major New England frozen fishery products have been developed at this laboratory. These products are fish sticks, fish blocks, raw breaded portions, haddock fillets, cod fillets, ocean perch fillets, and fried breaded scallops--the last two being developed in fiscal year 1961. Standards are being developed for fried fish portions and pollock fillets. The standard for frozen fried fish sticks, adopted in 1956, is now being revised to reflect current production



The analytical chemistry laboratory where studies are made of the composition of North Atlantic fish and shellfish.

practices. Newer standards or revisions are being simplified in application without sacrificing their objectivity in order to aid inspectors in grading several types of products each day.

As a direct aid to the consumer and the producer in attaining higher quality, our laboratory, under contract with a private engineering firm, is investigating the use of X-rays in detecting bones in fishery products. This research now has shown that bones as thin as 0.012 inch can be readily detected in frozen fish portions at assembly-line speeds of 15 to 25 feet per minute.

Specifications Development

This project is concerned with the development of specifications for fishery products for use by Federal and State agencies. The Armed Services are the largest purchasers of seafoods, and the specifications program is designed to assist them in obtaining products of high quality. The laboratory is also cooperating with the National Association of State Purchasing Officials in developing quality specifications that State governments can use in buying

seafoods. This cooperative program will provide the States with the tools necessary to procure only high-quality fishery products for use in their many institutions.

Federal specifications have recently been published as "interims"--that is, as trial specifications--for frozen raw breaded shrimp, chilled and frozen fish, and canned sardines. Federal specifications for canned tuna, raw shucked oysters, canned clams, and canned shrimp are now in the final stages of completion.

Specifications being developed for the National Association of State Purchasing Officials include frozen ocean perch fillets, frozen cod or haddock fillets, and frozen raw breaded and fried scallops. New state purchasing specifications are being designed for frozen fish portions, frozen shrimp, and canned tuna.

INSPECTION AND CERTIFICATION OF FISHERY PRODUCTS

The standards and specifications program is carried out in conjunction with the U.S. Department of Interior's Inspection and Certification Service, which in the North



Grading of ocean perch fillets using grade standards.

and Middle Atlantic areas has its headquarters at the Gloucester laboratory. At present, 10 plants in the area from Maine to Maryland are using the Department's continuous inspection service, thus putting into direct use the standards of quality developed at Bureau laboratories. During fiscal year 1961, 60 million pounds of fishery products in the North and Middle Atlantic areas were given the Department's quality approval, either under continuous or lot inspection.

PRESERVATION AND ENGINEERING RESEARCH

Studies are in progress on the effect of storage of fish in refrigerated sea water as

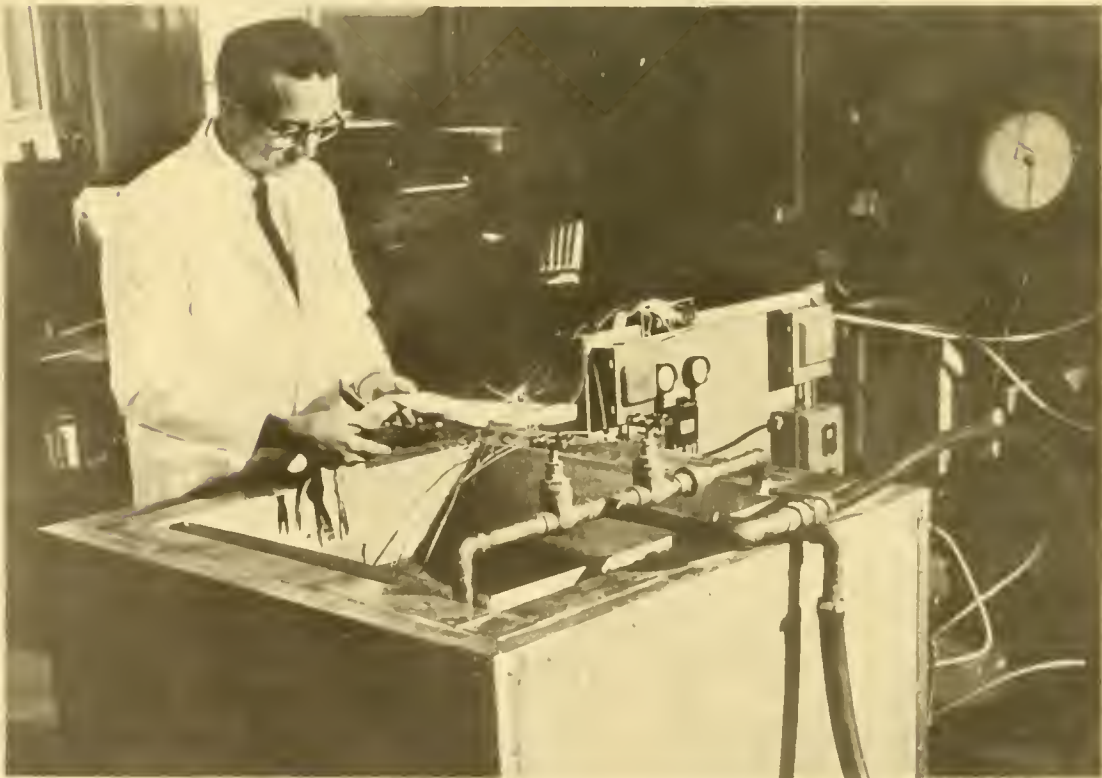
compared to ice, the effect of storage and distribution practices on the quality of frozen seafoods, the development of immersion-freezing solutions, and the efficiency of an automatic capacity-control system for regulating the temperature of cold-storage rooms.

Storage of Fish in Refrigerated Sea Water

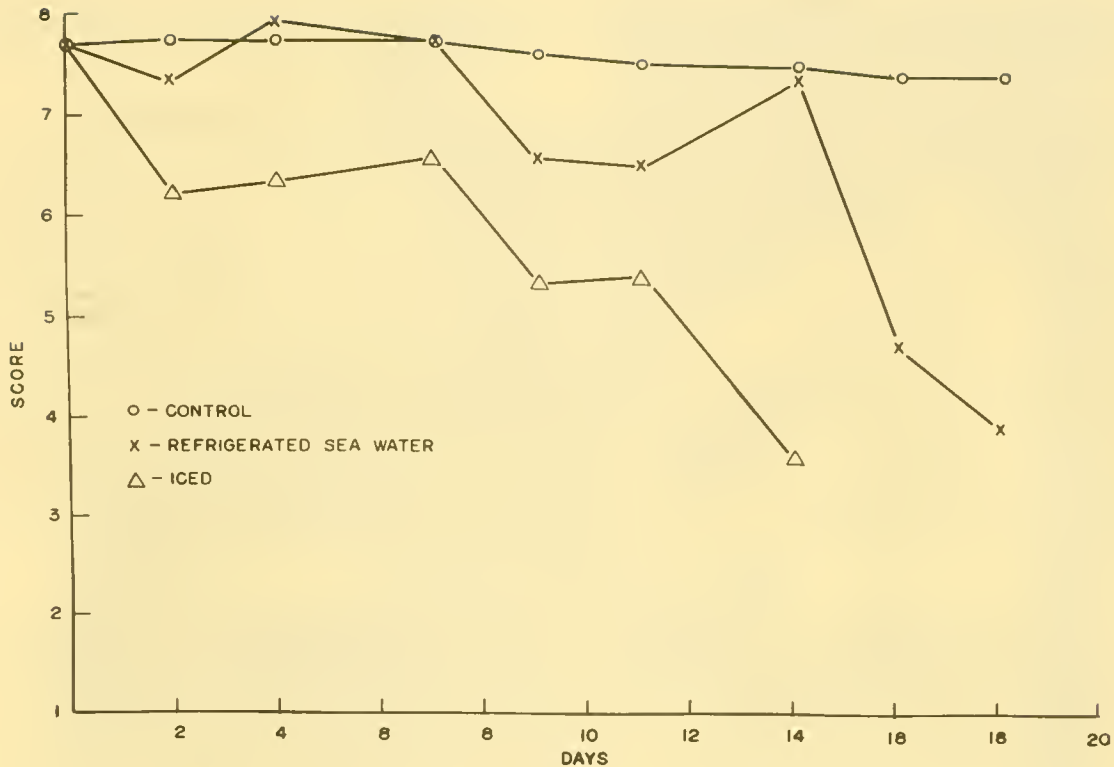
Results of commercial-scale and laboratory studies on the storage of fish in refrigerated sea water held at 30° F. (-1°C.) indicate that fish stored in this medium will keep longer than fish stored in ice. Whiting kept in ice were of edible quality for only



A U.S. Department of the Interior inspector examining fish sticks in a processing plant.



Examining whiting stored in 30° F. refrigerated sea water.



Taste panel evaluation of whiting stored in refrigerated sea water and in ice. Score: 8-excellent, 7-very good, 6-good, 5-fair, 4-inedible.

7 to 9 days, whereas similar fish stored in refrigerated sea water were of good quality for 10 to 14 days. Similar results have been found in tests on ocean perch. Chemical analyses for total protein and for amino acids in whiting showed no change in protein in fish stored in refrigerated sea water but showed a significant loss of protein by those stored in ice.

Storage and Distribution of Frozen Seafoods

Another major phase of the preservation program includes studies on the storage and distribution of frozen seafood. Information is being collected on the temperature and other conditions encountered during storage, transportation, and marketing of frozen fishery products and on the effect of these factors on the quality of the marketed product. As part of this project, a comprehensive questionnaire entitled "Survey on Handling Frozen Seafoods" was sent to over 300 representative processors, cold-storage warehousemen, distributors, and retailers. The returns from this survey

are yielding information that will be of value in pinpointing problem areas in the distribution of frozen seafoods and in designing future research in which the effect on product quality of constant and cyclical temperatures within the ranges found in actual practice will be determined.

Improved Solutions for Immersion-Freezing Fish at Sea

One of the first research projects undertaken by this laboratory when it was located in East Boston resulted in the development of a successful method of immersion-freezing fish at sea. Industry's re-awakened interest in this technique has prompted an investigation into the development of solutions to replace the previously used sodium chloride brine. As one phase of the research, this laboratory has contracted with the University of New Hampshire to develop an immersion-freezing solution that is nontoxic, inexpensive, and easily refined; has a freezing point of about -20° F. (-33° C.); and has low viscosity at low temperature.

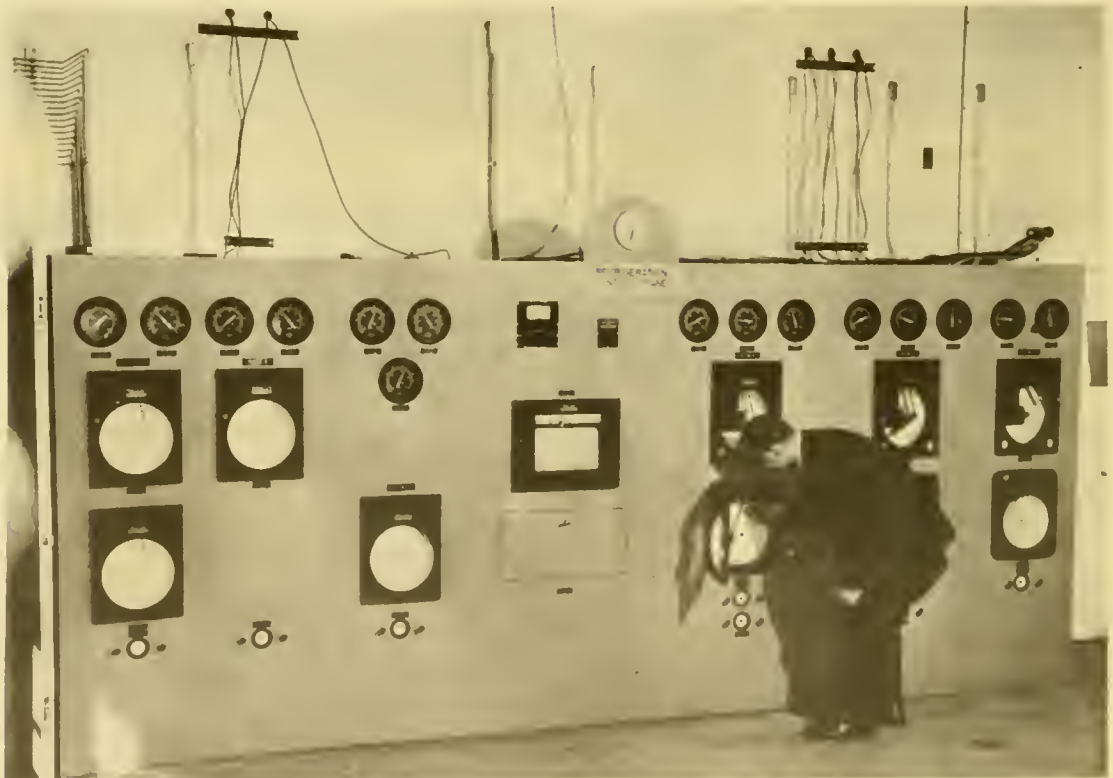
Capacity-Control System for Cold Storage Rooms

Laboratory engineers have designed a refrigeration control system that provides improved flexibility of temperature control in the cold-storage rooms that are used for research on frozen seafood. In this system the capacity of the refrigeration compressor, which operates continuously at constant speed, is automatically varied to provide a cyclic pattern of change in room temperature with any desired waveform in the range of -30° to $+40^{\circ}$ F. (-34° to $+4^{\circ}$ C.). It also permits holding a storage room at a constant temperature in this range. Such versatility of control is impossible using conventional methods of control. Studies are in progress to compare operating costs and efficiencies of

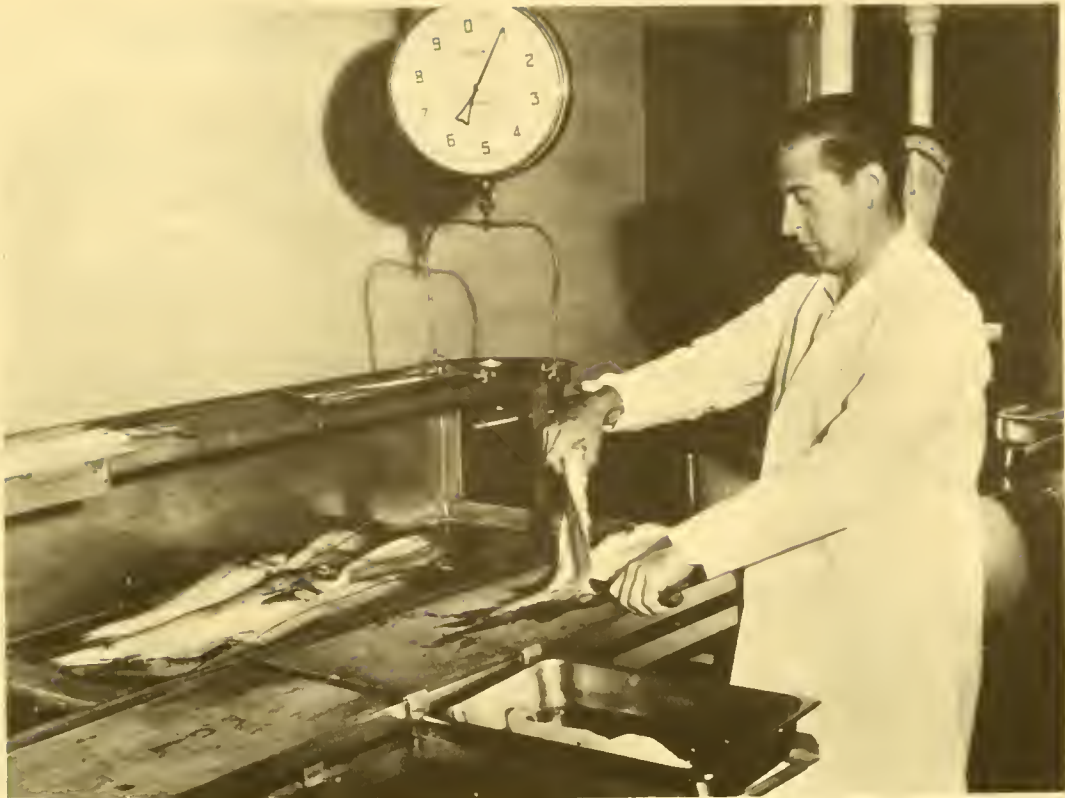
this system with those of a conventional off-on thermostatically controlled system.

Radiation-Pasteurization Research

An investigation of the radiation-pasteurization of fish is being carried out under contract with the U.S. Atomic Energy Commission. This research, which will provide data on the nutritive properties of irradiated haddock fillets and clam meats, is the first phase of a comprehensive program on the use of atomic energy for the preservation of food for civilian use. Successful completion of this project may make it possible to use low-level ionizing radiation to preserve large quantities of fresh marine fish and shellfish while they are being transported to midwestern markets.



The control panel for the laboratory refrigeration facilities.



Filleting fresh haddock preparatory to preservation by radiation.

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