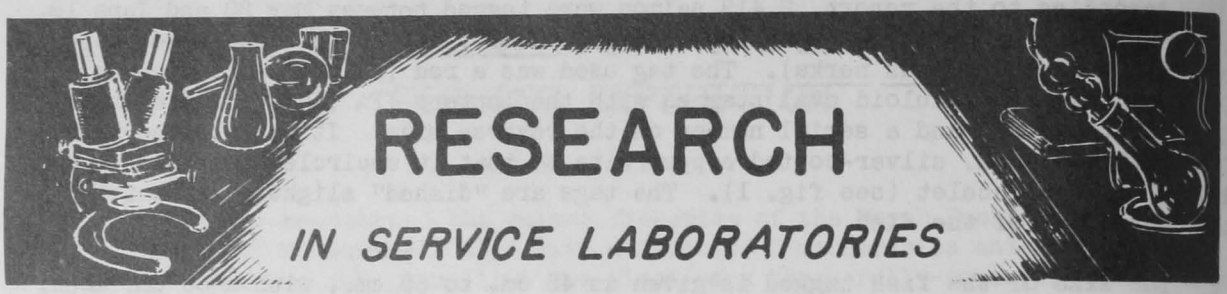

Progress on Projects, April 1953

REFRIGERATION: Freezing Fish at Sea, Defrosting, Filleting, and Refreezing the Fillets: VESSEL OPERATIONS: The Delaware remained dry-docked at the shipyard in Chelsea, Mass., during which time it was painted and overhauled and the brine-freezer tank was modified.

LABORATORY STUDIES: Further tests were carried out on dipping fillets in brine. From a local trawler 600 pounds of gutted scrod haddock were obtained and stored in ice at the laboratory. At intervals of 1, 5, and 10 days, one-third of the lot was filleted, dipped in brine, packaged, frozen, and later examined (table 1).

Table 1 - Effect of Dipping Haddock Fillets in Brine

Description of Samples			Weight Increase of Fillets	Salt (as NaCl) in Fillets	Results of Objective Tests on the Thawed Frozen Fillets			
Sample	Group No.	Concentration of Brine Dip			Free Drip of Fillets	Press Drip of Fillets	Solids in Press Drip	Tenderometer 1/ Value of Fillets
		Percent Salt By Weight	Percent	Percent	Percent	Percent	Percent	Pounds
Haddock, gutted, iced for one day	1	0.0	2.7	0.19	4.1	24.0	-	25
	2	0.8	4.1	0.25	3.2	25.8	5.2	25
	3	5.0	3.8	0.50	3.7	32.0	4.8	26
	4	10.0	3.5	0.79	1.5	21.3	5.0	25
	5	15.0	4.3	1.33	1.8	14.4	6.3	24
	6	20.0	4.5	1.91	1.5	14.8	6.3	24
	7	26.0	4.5	2.15	1.2	15.0	6.3	24
Haddock, gutted, iced for five days	1	0.0	3.4	0.20	5.2	31.0	4.9	24
	2	0.8	3.9	0.24	6.5	32.4	3.9	23
	3	5.0	4.9	0.58	3.3	30.7	4.8	26
	4	10.0	5.8	0.92	2.3	25.9	4.6	25
	5	15.0	5.8	1.23	1.1	24.9	5.2	25
	6	20.0	5.6	2.03	1.5	15.6	6.3	17
	7	26.0	5.9	2.78	1.4	14.7	5.6	17
Haddock, gutted, iced for ten days	1	0.0	3.2	0.19	1.3	29.7	3.5	25
	2	0.8	3.1	0.23	1.2	27.1	3.9	26
	3	5.0	3.8	0.59	1.0	30.6	3.7	24
	4	10.0	4.8	0.95	0.83	25.7	4.2	26
	5	15.0	4.8	1.37	0.31	20.3	4.7	22
	6	20.0	5.1	1.84	0.37	18.7	5.0	25
	7	26.0	4.9	2.33	0.29	16.6	5.7	24

1/TENDEROMETER VALUE VARIES INVERSELY WITH TENDERNESS OF FILLETS.

The tests indicated that storage of the fish in ice for various periods prior to filleting has little effect upon the fillets dipped in brine from the standpoints of salt absorption and weight increase, or upon tenderometer value, press drip, or press drip solids of the thawed frozen fillets. The dipped fillets from fish stored in ice for 10 days upon freezing and thawing showed lower apparent free-drip values as compared with the dipped fillets from fish stored in ice for 1 or 5 days.

The effect of brine temperature and time of immersion on the absorption of salt by whole scrod haddock during the freezing process was studied on a laboratory scale. Whole scrod haddock were procured from a local trawler about 24 hours

after the fish were landed on the vessel. The fish were held in a 23-percent salt solution for one hour at various temperatures. The effect of brine temperature on the penetration of salt into the fish is shown in table 2.

Table 2 - Salt Penetration Into Whole Scrod Haddock Held in 23-percent Salt Solution for 1 Hour at Various Temperatures

Sample	Brine		Concentration of Salt in the Fish Flesh	
	Concentration	Temperature	First 1/4-Inch	Second 1/4-Inch
	Percent Salt	Degrees F.	Percent	Percent
Whole scrod haddock	23	-6	0.37	0.15
		0	0.51	0.19
		5	0.55	0.24
		10	0.64	0.23
		15	1.15	0.24

The results indicate that freezing the whole scrod haddock at 10° F. or below produces much lower salt penetration in the fish than freezing at temperatures above 10° F.

Table 3 shows the effect of immersion time of the fish on the salt penetration. The results indicate an initial high rate of salt penetration in the first 1/4-inch of flesh during the first hour of freezing. Further absorption continued at a much reduced rate, particularly at the lower temperatures.

Table 3 - Absorption of Salt in Whole Scrod Haddock Immersed in 23-percent Salt Solution at Various Temperatures for Varying Periods

Sample	Temperature of the Brine	Immersion Time	Concentration of Salt in the Fish Flesh	
			First 1/4-Inch	Second 1/4-Inch
	Degrees F.	Hours	Percent	Percent
Whole scrod haddock	5	1	0.55	0.24
		1½	0.71	0.23
		2	0.91	0.31
		3	1.17	0.21
		4	1.22	0.20
		24	2.09	0.84
	10	1	0.64	0.23
		1½	0.87	0.30
		2	1.10	0.26
		3	1.25	0.35
		4	1.29	0.24
		24	-	-
	15	1	1.15	0.24
		1½	-	-
		2	1.27	0.28
		3	-	-
		4	1.39	0.21
		24	5.15	3.01

Results of prolonged immersion-freezing in 23-percent salt solution is shown in table 4.

Thawing was first noticeable as a very slight softening of the skin of the fish. As salt continued to penetrate into the flesh, thawing or softening occurred at greater depths. Shrinkage, due apparently to loss of water from the fish, was observed after 48 hours of immersion of the fish and eventually became so great as to cause outlines of the muscular striations to appear on the skin. After four

days the tail section became pliable; this condition spread slowly to about one-third the length of the fish at the time the test was terminated. The fish immersed for 24 hours would not take a glaze due to the high salt content of the surface layer of the fish.

Table 4 - Effect of Prolonged Immersion-Freezing on Whole Scrod Haddock

Treatment of Sample	Immersion Time	Initial Weight of Fish	Weight Loss of Fish	Depth of Thaw or Softening	Salt Content of the Flesh
	Days	Grams	Percent	Inches	Percent
Whole scrod haddock were immersed in 23-percent salt solution at 5° F.	1	2,320	0.8	0	1.01
	2	2,330	1.7	1/32	2.22
	4	2,635	1.7	3/32	4.68
	6	2,215	3.1	5/32	7.40
	8	2,430	1.9	7/32	6.21
	10	1,845	8.1	9/32	10.58
	12	2,050	1.7	9/32	10.1

(Boston)

* * * * *

Freezing, Glazing, and Thawing Salmon to be Canned: Examination was made of four lots of canned sockeye salmon prepared last fall from fresh (unfrozen) fish, and from frozen fish containing varying amounts of added salmon oil. The purpose of the test was to determine the amount of curd formation and appearance of the final product when salmon oil is added to canned salmon (prior to sealing and processing) prepared from frozen fish. Six 1/2-flat cans of each of the following four lots of canned sockeye salmon were examined:

1. Prepared from brine-frozen fish--salt added.

2. Prepared from brine-frozen fish--salt and 3 milliliters of salmon oil added to each 1/2-flat can.

3. Prepared from brine-frozen fish--salt and 6 milliliters of salmon oil added to each 1/2-flat can.

4. Prepared commercially from fresh (unfrozen) fish--salt added.

The results are shown in table 1.

Table 1- Results of Tests on Canned Alaska Sockeye Salmon Prepared from Fresh (Unfrozen) and Frozen Fish (Frozen fish were packed with and without added oil. Six cans from each lot were examined.)

Lot No.	Description of Canned Sample				Characteristics of the Canned Product				
	Raw Material	Materials Added to Can		Can Size	Volume of Aqueous Liquid	Volume of Free Oil	Drained Weight	Amount of Curd	Penetrometer Value 1/
		Salt	Salmon Oil		Milliliters	Milliliters	Grams		Millimeters
1	Brine-frozen	yes	none	½-flat	28.4	1.6	203	Moderate	12.3
2	Brine-frozen	yes	3	½-flat	28.8	2.8	206	Moderate	12.8
3	Brine-frozen	yes	6	½-flat	32.8	5.3	203	Moderate	13.7
4	Fresh (unfrozen)	yes	none	½-flat	38.9	2.4	188	Trace	15.8

1/ PENETROMETER VALUE VARIES INVERSELY WITH THE FIRMNESS OF THE PRODUCT.

In comparison with lot 4 (prepared from fresh fish), lot 1 (prepared from brine-frozen fish) had on the average a smaller volume of free aqueous liquid and free oil, and a lower penetrometer reading (or firmer texture). Lot 4 possessed a natural salmon flavor and odor and had only a trace of curd. Lot 1 had lost some

f the natural flavor and odor and some of the samples showed incipient rancidity; ad a firm texture, which was not considered too objectionable; and had a moderate mount of curd, which lowered the appearance rating. Although a definite differnce in texture between the two lots (1 and 4) was found by both organoleptic exmination and penetrometer tests, some of the difference may have been due to the ethod of packing. Lot 1 was hand packed while lot 4 was machine packed commerially.

Adding natural salmon oil to each can (lots 2 and 3) increased the amount of ree oil in the final product; however, the curd appeared in more compact layers nd made the appearance of the fish in the can less desirable.

* * * * *

ANALYSIS AND COMPOSITION: Cooperative Work with the A.O.A.C. on the Determination of Oil in Fish Meal: Work has been resumed on this project in an effort o develop a simple and rapid procedure for the determination of oil in fishmeal. hemists in the industry have indicated that the acetone extraction method, devehowever, consumes too much time. n the earlier work, it was found that acid hydrolysis did not completely digest he fish meal to the extent that it does fish flesh. The tests now under way are esigned to determine whether or not the acid hydrolysis procedure can be improved o provide complete hydrolysis of the meal and effect more accurate oil determinaions. Preliminary tests indicate that more complete hydrolysis of the meal is facilitated by grinding the meal exceedingly fine and using a high ratio of acid o meal.

(Seattle)

CEMENT FROM SEA SHELLS

A plant designed specifically for the production of cement from coquina (periwinkle) shells has been constructed at Flagler Beach, Florida, on a 10,000-acre site, to produce 10,000 to 15,000 barrels of cement per day from 3,000 tons of shell. Borings in the area indicate the presence of enough accumulated shell to supply a plant of the size described for at least 100 years. (Chemical and Engineering News, May 26, 1952)

TECHNICAL NOTE NO. 26--GLAZING BRINE-FROZEN SALMON

Frozen whole fish in cold storage are usually protected by an ice glaze. This glaze, a thin shell of ice around the fish, is formed when frozen fish are given a short dip in chilled water. The purpose of the glaze is to serve as a barrier against the loss of moisture and to prevent air from coming into contact with the fish. It thus protects the fish from dehydration and retards the rate of oxidative deterioration, including the development of rancidity and rusting.

There are several factors that can interfere with the formation of a good glaze. Patches of oil may form on the surface of the fish and cause the dip water to run off these areas before it can freeze and adhere. Similarly, slime and blood may also contribute to a poor glaze. In brine-frozen fish the presence of absorbed salt can make glazing difficult. The salt lowers the freezing point of the water glaze, and a good glaze may not be possible in the range of about 0° F. to 10° F., the storage temperatures commonly used commercially.

Recently, inquiries have been received regarding the feasibility of glazing brine-frozen fish. In order to observe the nature and extent of the problems involved in glazing such fish, a brief experiment was conducted. Brine-frozen salmon were used as they were readily available from the increasingly large number brought from Alaska to the Pacific Northwest for canning.

Red salmon that were caught in Bristol Bay during the 1952 fishing season were obtained from one of the freezerships unloading at Seattle, Washington. These fish had been frozen by immersion for about 12 hours in a saturated brine solution at approximately 5° F. and then transferred to a dry hold for storage at 5° F. When the fish were obtained from the vessel, they were slightly thawed at the outer surface, but otherwise appeared to be in good condition. Ten of the fish were placed in storage at 0° F. and ten at -20° F.

The ten salmon that had been stored at 0° F. for several days were glazed by immersing in water cooled to around 34° F. They were allowed to age for several hours at 0° F., and then the glaze was examined and evaluated. The glaze taken by the fish varied from good to poor in both quantity and quality. On some parts of the fish the glaze was "soft" (not hard frozen) and rubbed off easily; this probably was due mainly to a high salt concentration in that particular area. In other small areas there was no glaze whatever because the water had run off before it could freeze. Only 2 out of 10 fish took a complete glaze. All ten fish were then sprayed with water and scrubbed with a brush to remove some of the salt, oil, blood, and slime from the surface. This washing increased slightly the amount of glaze that the fish would take; however, the glazing as a whole could not be considered satisfactory.

To determine whether these brine-frozen salmon would take a good glaze at a lower temperature, ten other fish that had been stored at -20° F. were dipped in cold water and then returned to the -20° F. room. All ten fish took a good glaze. Later, three of these fish were transferred to the 0° F. room and were examined the following day. Although the glaze was still intact, the ice had softened in some parts, particularly on the head. On contact, this soft ice easily fell away from the fish. In comparison, the glaze on the fish left in the -20° F. room was still hard. No tests were made at temperatures between 0° F. and -20° F.

SUMMARY

The salt absorbed by brine-frozen fish interferes with successful ice-glazing of fish at storage temperatures commonly used commercially (0° F. to 10° F.). The

glaze taken by brine-frozen Alaska red salmon at 0° F. was not considered satisfactory; however the glaze taken at -20° F. was good. Since glazing of the brine-frozen salmon does not appear feasible at the storage temperatures now used by the freezerships (about 5° F.), these fish will be more susceptible to dehydration and oxidative deterioration upon prolonged storage. It therefore is highly important to process these fish as soon after freezing as possible in order to have a good quality canned product.

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Fishery Technological Laboratory,
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U.S. Fish and Wildlife Service,
Seattle, Washington.

HOME FREEZERS EXPAND FROZEN FOOD MARKET POTENTIAL

Since the war, nearly 5 million home freezers have been sold with the result that around 12 percent of the nation's 42 million electrically-wired homes now have a freezer. According to a recent survey by Electrical Merchandising, 1,140,000 home freezers were sold in 1952, a 9 percent gain over 1951, when sales totaled 1,050,000 units. Also, the larger freezers are becoming more popular.

Several government and industry surveys have shown that a family with a home freezer almost invariably uses more frozen foods. In towns under 5,000 population, which often have no other local frozen-food distributors, many locker plants have gone "all out" to sell frozen food to home-freezer owners. A large number of the nation's 11,000 locker-plant operators feel that their business future lies in the success with which they can become the "frozen food center" of their communities.

The locker-plant associations and trade magazines have been doing a great deal to help locker-plant operators become "frozen food centers." Many operators have had difficulty in securing frozen foods at competitive prices, so a national trade magazine has started a directory service listing free of charge frozen-food packers interested in sales to locker plants. Eight companies selling fishery products are now included in this directory.

The U. S. Fish and Wildlife Service has been working with the locker plants, their national association, and their trade magazines, to call attention to the profit possibilities in the sale of frozen fishery products. The Service has found that many operators already handle fish and shellfish. However, with greater knowledge of fishery products and their availability, plus some merchandising tools, e.g., signs and recipe booklets, sales of fish by locker plants could be greatly increased.