Progress on Projects, January 1953

ANALYSIS AND COMPOSITION: Composition and Cold-Storage Life of Fresh-Water Fish: Proximate composition of 16 carp and 6 lake trout was determined. Results are presented in the following tables:

Composition of Edible Portion of Carp

Species	Sample No.	Length	Weight of Whole Round Fish	Fillet Yield from Whole Round Fish	Proximate Composition of Edible Portion			
					Moisture	Fat	Protein	Ash
		Centimeters	Grams	Percent	Percent	Percent	Percent	Percent
Carp (Cyprinus carpio) 1/	1	28.0	350	28.6	83.3	1.28	15.6	0.81
	2	29.5	375	29.3	82.7	4.55	16.8	0.94
	3	31.5	465	27.0	80.8	1.78	17.8	1.00
	4	32.0	495	31.7	79.0	2.10	18.4	1.06
	5	25.5	265	29.4	80.7	1.03	18.1	1.02
	6	31.5	475	31.6	80.2	1.41	18.6	1.00
	7	50.5	2,080	27.0	71.1	12.50	16.9	0.96
	8	53.5	2,020	31.0	74.0	8.60	17.8	1.01
	9	54.5	1,970	29.0	74.7	8.60	17.1	1.00
	10	51.0	1,725	30.0	79.1	3.45	17.8	1.14
	11	50.5	1,825	25.0	74.6	9.53	17.4	1.27
	12	52.0	2,040	29.0	74.4	10.29	17.4	1.09
	13	50.0	1,625	26.0	72.6	9.68	17.0	0.99
	14	53.0	1,900	30.0	72.9	10.66	16.3	1.11
	15	52.0	1,965	25.0	75.7	7.11	18.1	1.17
	16	53.0	1,995	32.0	75.6	7.84	17.5	1.03

1/ CAUGHT IN LAKE BENTON, MINNESOTA, IN AUGUST 1952.

Composition of Edible Portion of Lake Trout

Species	Sample No.	Length	Weight of Drawn (eviscerated) Fish	Fillet Yield from Drawn (eviscerated) Fish	Proximate Composition of Edible Portion			
					Moisture	Fat	Protein	Ash
		Centimeters	Grams	Percent	Percent	Percent	Percent	Percent
Lake Trout (Cristivomer namaycush) 1/	1	94	6,804	61	67.6	13.97	15.8	1.01
	2	84	5,670	57	65.1	16.20	19.1	1.08
	3	77	3,855	55	68.4	13.90	18.8	1.05
	4	72	2,500	55	76.1	6.47	16.0	1.06
	5	70	3,035	64	64.3	19.38	17.1	1.08
	6	72	2,515	62	70.2	11.22	19.4	1.10

1/ CAUGHT IN LAKE SUPERIOR NEAR ISLE ROYALE IN JUNE 1952.

(Seattle)

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REFRIGERATION: Freezing Fish at Sea, Defrosting, Filleting, and Refreezing the Fillets: VESSEL OPERATION: Inclination tests were carried out on the research trawler Delaware by representatives of a commercial boat-building concern to determine the vessel's stability under various load conditions. Results of the tests indicated that the addition of the proposed modified brine-freezing equipment will not materially affect the stability of the vessel.

LABORATORY: Effects of brine concentration on haddock and scrod haddock fillets during the brine-dipping process are being studied. Tap water and six brine solutions (with concentrations of: 0.8, 5.0, 10.0, 15.0, 20.0, and 26.0 percent sodium chloride by weight) have been used. Sixty pounds each of scrod haddock fillets (separated into seven 8.5-pound groups) and haddock fillets (separated into seven 8.5-pound groups) were used. Under controlled conditions, each group of scrod and haddock fillets was immersed in one of the brines. Immersion was for exactly 20 seconds in all cases. Each group was allowed to drain on a screen for two minutes, weighed, wrapped in moisture-vaporproof cellophane, boxed, and frozen in a plate freezer (-50° F. on the plates).

After several weeks in frozen storage determinations for salt, free drip, press drip, total solids in press drip, and toughness will be made on representative samples from each group. The effect of salt absorption upon the palatability of the fillets will also be studied. Preferences of the taste panel for the cooked samples will be scored to give information as to the individual taste threshold for salt, and to determine the relative saltiness of the various samples.

(Boston)

SOURCES OF INFORMATION CONCERNING THE COMMERCIAL FISHERIES

Fishery Leaflet 362, Sources of Information Concerning the Commercial Fisheries, was recently issued. Various publications from which information on commercial fisheries (especially of the United States) may be obtained are listed in this 23-page leaflet. It is not meant to be a complete bibliography; therefore, only principal contributions or bibliographies are listed. References are listed under the following major categories--byproducts, canning, freezing, gear, marketing, statistics, consumption, cookery, directories, employment, salting, sanitation, smoking, spoilage, technical journals, trade journals, and visual aids. Basic sources are indicated.

For free copies of this leaflet write directly to the Division of Information, U. S. Fish and Wildlife Service, Washington 25, D. C.

TECHNICAL NOTE NO. 24--A PORTABLE IMMERSION FREEZER

REQUIREMENTS

Evaluation of the commercial feasibility of freezing "round" fish at sea for subsequent thawing and processing into frozen fillets ashore is one of the projects for the Boston Laboratory of the U. S. Fish and Wildlife Service. The fish are being frozen by immersion in a cold (5° to 10° F.) sodium-chloride brine on board the research trawler Delaware (Magnusson, Pottinger, and Hartshorne 1952). Representative samples of the fish frozen at sea are analyzed in the laboratory to determine extent of salt penetration into the fish.

Tests at the laboratory have shown that salt penetration into fish by the freezing medium has been proven of minor concern. However, to formulate methods of freezing which would further minimize penetration, knowledge of the factors which govern penetration is necessary. The strict control of immersion time, brine temperature, and brine concentration necessary for such studies is not practicable in the large freezer on board the vessel. Furthermore, small scale studies on the suitability of immersion-freezing media other than sodium-chloride brines would seriously interfere with the scheduled operation of the larger freezer aboard the vessel. For these reasons, a portable immersion freezer, having a relatively wide temperature range and affording accurate control at a given temperature, was constructed.

The freezing apparatus, built somewhat along the lines of a laboratory constant temperature bath (Tappel 1951), was designed to fill the following requirements:

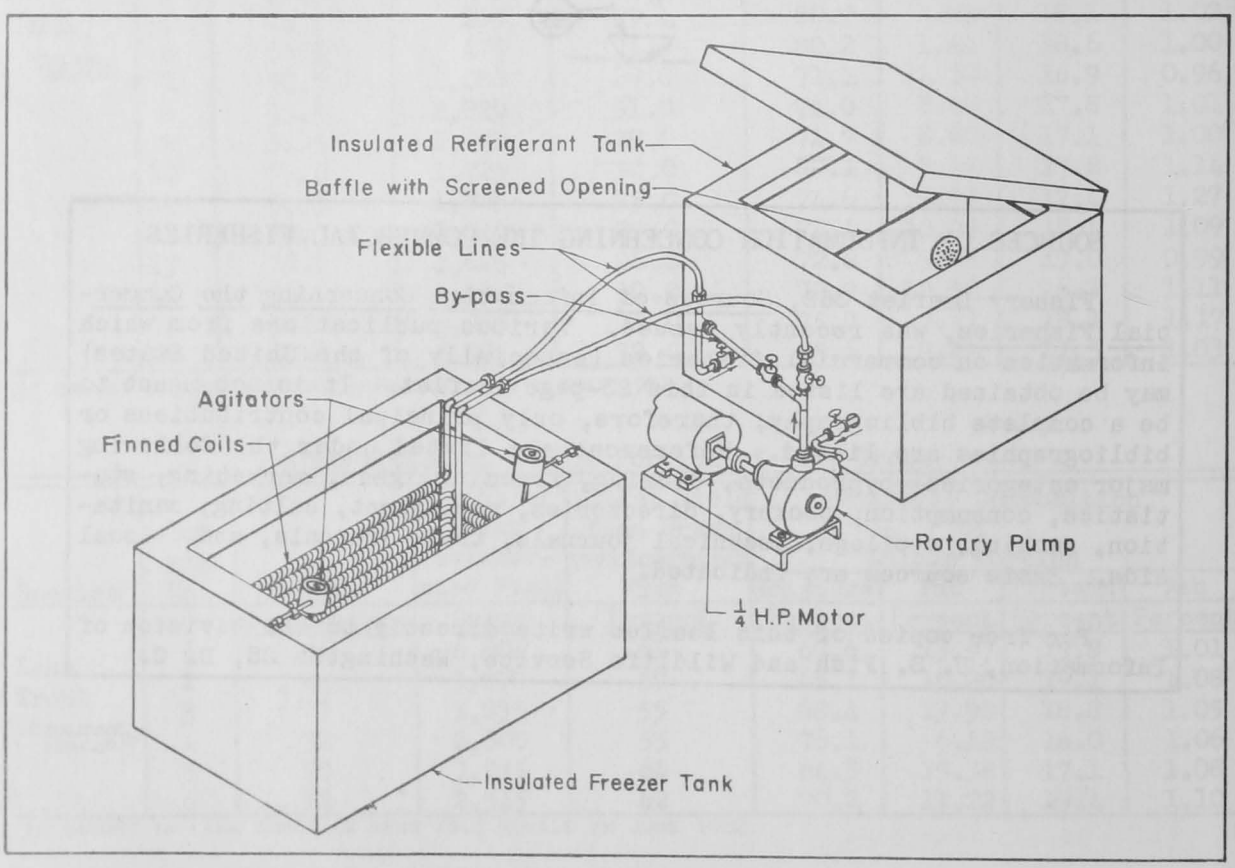

FIGURE 1 - DIAGRAM OF THE PORTABLE IMMERSION FREEZER.

1. Allow rigid control of immersion time of the fish and brine temperature during the freezing process.

2. Facilitate easy and rapid changes in concentration or composition of the freezing medium.

3. Be easy to transfer from laboratory to vessel and be capable of operation at either location.

4. Have sufficient capacity to lower the temperature of the freezing medium to -40° F. and to maintain the temperature to within ±1° F. when 4 or 5 haddock (approximately 12 pounds) are immersed in the medium.

5. Have a relatively low initial cost.

6. Have a low electric power demand, since power available on the vessel is limited.

7. Be easy to dismantle for cleaning.

A survey of available literature on low-temperature baths had revealed that the use of mixtures of solidified carbon dioxide (dry ice) and alcohol afford an efficient means of attaining and holding the desired temperatures. The vaporization of the pieces of dry ice is accomplished by extraction of heat from the alcohol. By use of sufficient quantities of dry ice, the temperature of the alcohol may be reduced to values approaching that of the sublimation temperature of carbon dioxide (-109° F.). Chilled in this manner, alcohol serves as an excellent cooling medium.

DESCRIPTION OF APPARATUS

The apparatus consists essentially of two insulated tanks (fig. 1). One, the refrigerant tank, contains the alcohol dry-ice mixture. The other, the freezing tank, contains the immersion-freezing medium and a coil of finned tubing. A rotary positive displacement pump, powered by a ¼-hp. motor, circulates the chilled alcohol from the refrigerant tank through the coils in the freezing tank by means of a piping system suitably equipped with valves and flexible connections. Two laboratory stirrers are mounted on the freezing tank to agitate the freezing medium. The tanks, fabricated from stainless steel, fit snugly into plywood casings which are insulated with four inches of glass wool. The refrigerant-tank casing is equipped with an insulated hinged cover.

The refrigerant tank, 18 inches square by 16 inches deep, is divided into halves by a vertical removable baffle which is fitted with a screened opening. The inlet for warmed alcohol from the freezing tank is on one side of the baffle and the outlet for chilled alcohol on the other. Since the dry ice is added only on the inlet side, the baffle insures adequate contact of the warmed alcohol and the cold dry ice. Also, the baffle screen prevents passage of the dry ice to the outlet side and thence through the coil system. The inlet and outlet fittings on the refrigerant tank can be removed to facilitate dismantling of the tank for transportation and cleaning.

The freezing tank coil, fabricated from ¾-inch finned copper tubing and having a total heat exchange area of 60 square feet, clears the sides of the 30 x 14 x 14-inch freezing tank by ½-inch on all sides. The coil, a self-supporting unit, can be easily removed from the tank.

The circulating pump is rated at 8 gallons per minute against a 20-foot head. It is powered by either an a. c. or a d. c. 110-volt motor. The d. c. motor is used when the freezer is operated on board the vessel. A flexible coupling on the drive shaft affords easy interchangeability of the motors. Unions in the $\frac{3}{4}$-inch piping system permit the tanks, coil, and pump to be disconnected for ease in handling. The 3-foot flexible pipe connections between the tanks provide freedom in positioning the various parts of the apparatus to conform to the restricted space available on board fishing vessels.

Piping and valves are connected in such a manner as to allow optional bypassing of the coil in the freezing tank. This provides flexibility in controlling the flow of alcohol and eliminates the necessity of stopping the positive displacement pump when no flow is required. The chilled alcohol is circulated through the bypass during periods of "no demand" in the coils. Such a system insures that the pump and its intake pipe will be kept sufficiently cold to prevent "flashing" of the dissolved gaseous carbon dioxide and consequent failure of the pump due to "vapor lock."

The temperature of the freezing medium is controlled by regulating the flow of chilled alcohol through the coils. Whereas hand valves, requiring considerable attention for proper temperature regulation, are used on the present apparatus, the system would lend itself well to automatic thermal control devices.

During the initial tests, an average cooling rate of 220 B. t. u./minute (1.1 standard refrigeration tons) was produced in the freezing medium. With the media used to date, an over-all coefficient of heat transfer of 10 B. t. u./hr./ft.^{2}/degree F. was indicated for the 60 square-foot surface area of the freezing tank coil. Temperatures of the medium, upon placing four haddock (average weight of three pounds each) in the freezing tank, were maintained to within $\pm 1^\circ$ F. of the desired temperatures.

This portable immersion freezer has been used in the laboratory and on board the trawler Delaware during two cruises. It has thus far been wholly satisfactory in performance.

LITERATURE CITED

MAGNUSSON, H. W.; POTTINGER, S. R.; AND HARTSHORNE, J. C.
1952. FREEZING FISH AT SEA - NEW ENGLAND: PART 2 - EXPERIMENTAL PROCEDURES AND EQUIPMENT. COMMERCIAL FISHERIES REVIEW, VOL. 14, NO. 2 (FEBRUARY 1952), PP. 8-15.

TAPPEL, ALOYS L.
1951. A BATH FOR CONSTANT LOW TEMPERATURES. THE CHEMIST ANALYST, VOL. 40, NO. 3 (SEPTEMBER 1951), PP. 69-70.

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