SALT CONTENT OF EVISCERATED HADDOCK FROZEN IN SODIUM-CHLORIDE BRINE

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ABSTRACT

Studies are reported on the salt content of the meat of eviscerated haddock frozen in a 23-percent sodium-chloride brine at temperatures of 5° F., 10° F., and 15° F. The results show that the commercial (quarter-nape) fillet from eviscerated haddock frozen at these temperatures contained from 0.57 to 0.70 percent salt. After the haddock had been thawed in water, the salt content of the commercial fillets obtained from the fish varied from 0.20 to 0.36 percent.

INTRODUCTION

Members of the New England fishing industry have expressed interest in the possibility of freezing eviscerated haddock in sodium-chloride brine. The advantages over the freezing of round haddock would be reduced freezing costs aboard the vessel, increased quantity of edible fish that can be landed, and reduced handling and storage costs ashore. Penetration of salt into the meat during brine-freezing, however, might be excessive, owing to the increased surface of fish that is exposed to the brine. Information on the penetration of salt into the meat of eviscerated haddock therefore must be obtained before this method of freezing can be recommended.

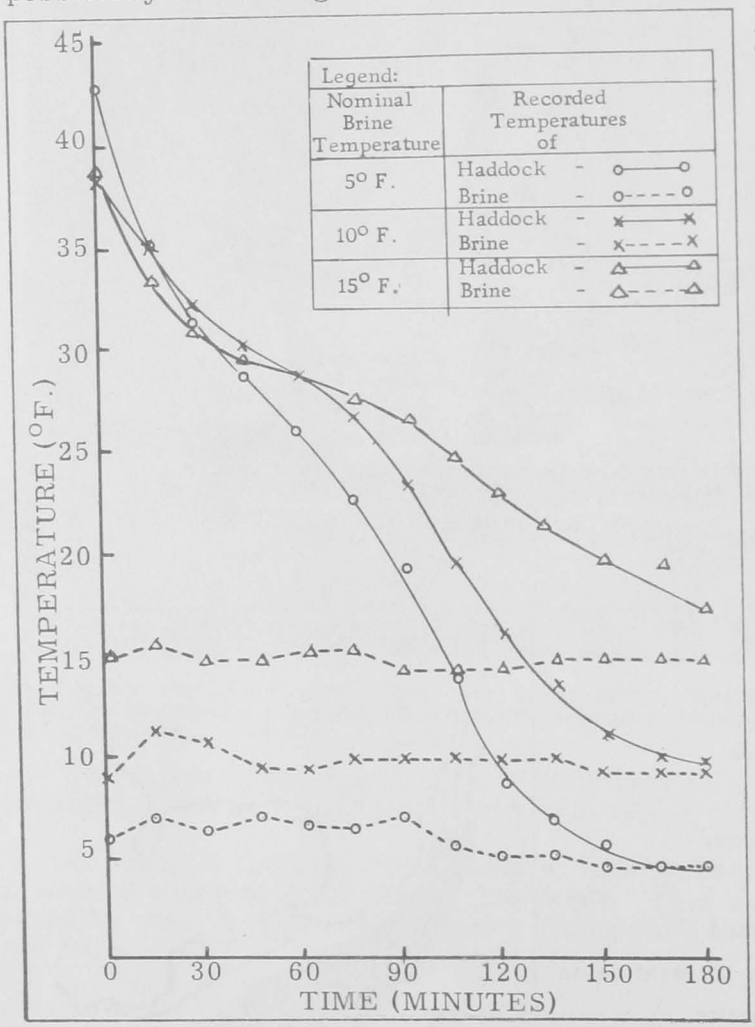

Fig. 1 - Freezing curves of eviscerated haddock in brine at various temperatures.

Studies at this Laboratory on freezing fish at sea have been concerned primarily with round fish. Holston and Pottinger (1954a and 1954b) found that when eviscerated scrod haddock were immersed in a 5° F. brine (23-percent sodium chloride) for 90 minutes, the salt content of the full-nape and quarter-nape fillets was 1.15 percent and 0.72 percent, respectively. Very little information is available, however, on the salt content of large eviscerated haddock frozen in brine at temperatures other than 5° F. or on the leaching of salt from the meat during the thawing of the fish in water prior to their filleting.

OBJECTIVES

The objectives of this study were (1) to determine the influence of various freezing temperatures on the sodium-chloride content of the edible meat of eviscerated

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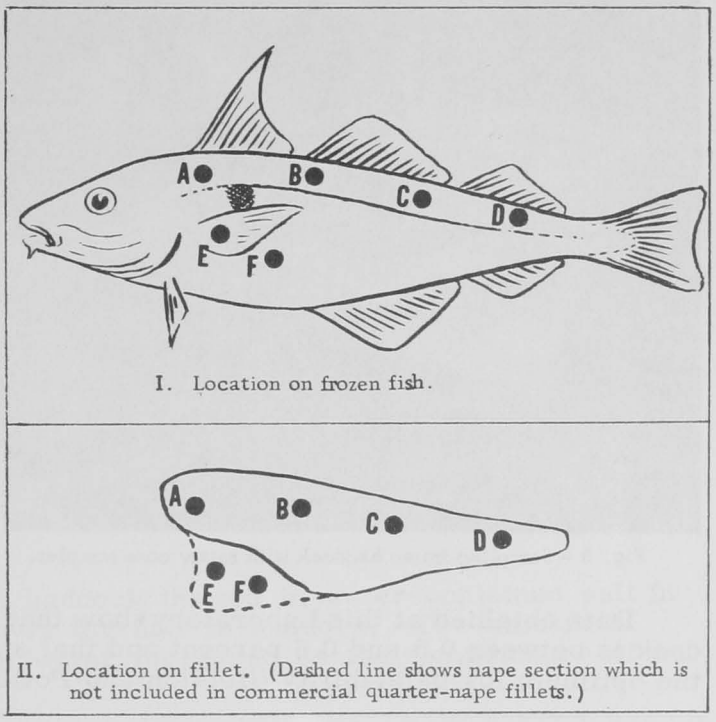
haddock frozen in a 23-percent sodium-chloride brine and (2) to determine the effect of water thawing on the sodium-chloride content of the edible meat of eviscerated haddock frozen in a 23-percent sodium-chloride brine.

EXPERIMENTAL PROCEDURES

EQUIPMENT: The freezer used in these tests consists of a galvanized steel tank with a capacity of about 100 gallons of brine. The tank is insulated with cork and covered on the outside with tongue-and-groove fir sheathing. The evaporator is made up of copper coils and is separated from the product-freezing section by a wooden baffle. The brine is circulated around the product and coils by a propeller-type mixer. A rectangular basket made of hot-dipped galvanized expanded metal is used to hold the fish during freezing.



I. Location on frozen fish.

II. Location on fillet. (Dashed line shows nape section which is not included in commercial quarter-nape fillets.)

Fig. 2 - Location of core samples taken from brine-frozen eviscerated haddock.

FREEZING THE FISH: The haddock used in this study were obtained from local line trawlers. The fish were eviscerated, washed, and heavily iced immediately after being landed on the vessel. The iced fish were transferred to the Laboratory within 24 hours of being caught; at the Laboratory, they were re-iced and stored in a chill room at 35° F. All of the fish used were not more than 48 hours out of the water and were of excellent quality.

Three 50-pound lots of fish (10 to 12 fish with an average weight of 4 to 5 pounds) were used in the study. Copper constantan thermocouples were inserted into the meat, just back of the gut cavity, of six fish in each lot, and two thermocouples were put in the brine. One lot was frozen in brine at 5° F., another in brine at 10° F., and the third in brine at 15° F.[1/] During freezing, the temperature of the fish and the brine were recorded by means of a multipoint recording potentiometer (fig. 1). All of the samples were left in the brine for 180 minutes. This freezing time was selected as being sufficient to insure complete freezing of this size of haddock at the various temperatures used and to fit best into commercial trawling operations.

SAMPLING THE HADDOCK FOR SALT DETERMINATION: Samples for determinations of salt were taken from the frozen eviscerated haddock and from full nape fillets cut from water-thawed haddock. One half of the haddock frozen at 5° F., 10° F., or 15° F. were sampled at the locations shown in figure 2-I, while the haddock were still frozen. These samples were taken by means of a rotary core sampler (fig. 3) developed at the Bureau's Seattle Laboratory (McKee 1957). The remaining fish were thawed in running water at 60° F. for 200 minutes.[2/] The thawed fish were filleted, using a full-nape cut. The fillets were sampled by means of a cork borer of the same inside diameter as the rotary sampler. The location of the samples was the same as for the frozen fish (fig. 2-II). All core samples were wrapped tightly in aluminum foil and stored at -20° F. until analyzed for salt.

1/ This range of temperatures includes those that may be encountered in commercial operations.

2/ It has been found previously (Magnusson and Hartshorne 1952) that at this time and temperature, 5-pound haddock will be sufficiently thawed to permit filleting.

SALT DETERMINATION: The skin was removed from all cores. The cores were cut to a length of $\frac{1}{2}$-inch (except for E and F from the nape section), giving samples each of which weighed approximately 2 grams. [3] Cores E and F from the nape section were approximately $\frac{1}{4}$-inch long after the lining of the visceral cavity were removed. Each of these cores weighed about 1 gram. Determinations of salt were made on the samples (fig. 4), using the modified Volhard method of the Association of Official Agricultural Chemists (1955).

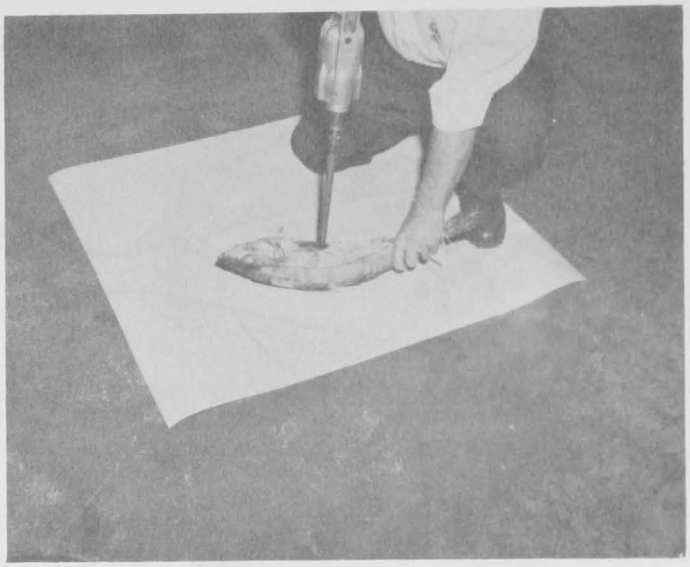


Fig. 3 - Sampling frozen haddock with rotary core sampler.

RESULTS AND DISCUSSION

Table 1 shows the average percentage of salt in the core samples from the brine-frozen eviscerated haddock and from the fillets prepared from water-thawed brine-frozen eviscerated haddock.

Data obtained at this Laboratory show that the taste threshold for salt in haddock is between 0.5 and 0.6 percent and that a salt content of 0.9 to 1.2 percent is the optimum for palatability (Holston and Pottinger 1955).

Table 1 - Average Percentage of Salt in Brine-Frozen Eviscerated Haddock [1]

Core [2] Section	Salt Content of Fish Sampled While Still Frozen After Having Been Frozen at a Brine Temperature			Salt Content of Fillets From Fish Thawed in Water for 200 Minutes After Having Been Frozen at a Brine Temperature of		
	5° F.	10° F.	15° F.	5° F.	10° F.	15° F.
	(Percent)					
A	0.57	0.69	0.58	0.18	0.32	0.34
B	0.60	0.73	0.49	0.20	0.29	0.46
C	0.50	0.68	0.68	0.18	0.24	0.23
D	0.60	0.70	0.61	0.22	0.28	0.39
E [3]	2.26	2.83	2.85	0.48	0.66	1.45
F [3]	2.84	2.59	2.49	0.61	0.54	0.85
Average of all cores	1.23	1.37	1.28	0.31	0.39	0.62
Average of cores A, B, C, D	0.57	0.70	0.59	0.20	0.28	0.36

1/ Previous tests (Holston and Pottinger 1955) showed that the salt content of haddock should not exceed 1.2 percent for maximum acceptability, and that the natural salt content of haddock meat is between 0.14 and 0.20 percent.
2/ See figure 2 for location of core sections.
3/ These cores were located in the nape section, which is discarded in commercial practice.

The results of the salt determinations on the samples from the frozen eviscerated haddock show that the cores from the nape section contained salt in amounts well above the optimum level. The salt content of the meat used in producing the usual quarter-nape fillet was at or only slightly above the threshold level of taste.

The results of the salt determinations on the core samples taken from full-nape fillets cut from water-thawed fish show that the nape section contained salt in amounts at or above the threshold level of taste. This is because both surfaces of the thin nape section are exposed to the brine during freezing. The salt in the quarter-nape fillet from these fish had been reduced to well below

3/ Previous tests by Holston and Pottinger (1954a) showed that very little salt penetrated beyond $\frac{1}{2}$-inch into the meat.

the taste threshold level of 0.5 to 0.6 percent, however, by the thawing process. Also, the temperature of the brine in which the fish were frozen had an influence on the amount of salt remaining in the fillets after they were thawed in water; with the use of the higher brine temperature, larger amounts of salt were left in the fillets.

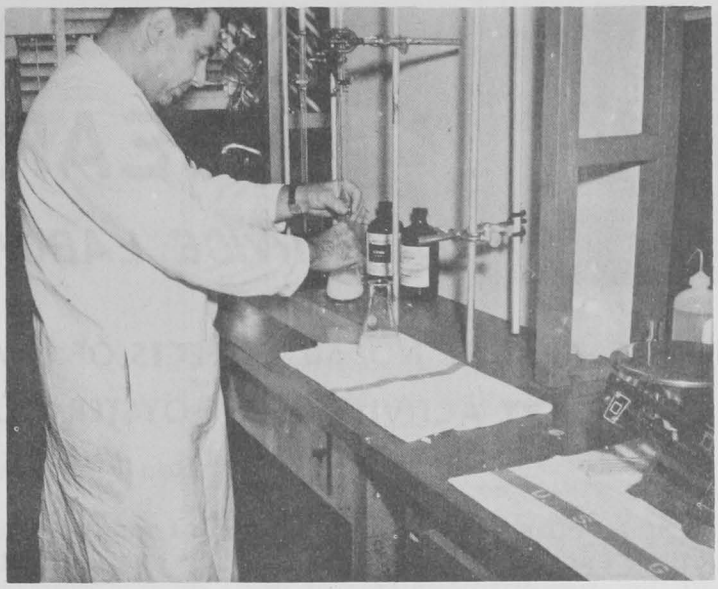


Fig. 4 - Determining salt in eviscerated brine frozen haddock.

CONCLUSIONS

(1) The meat representative of the usual commercial quarter-nape fillet from eviscerated haddock frozen in brine at 5° F., 10° F., or 15° F. and sampled while still frozen did not contain salt in excess of the optimum amount for palatability, but did contain salt in excess of the taste threshold level.

(2) The quarter-nape fillet from haddock thawed in water contained salt in amounts below the taste threshold level for salt in haddock. The amount of salt left in the meat after thawing in water increased as the temperature of the freezing medium increased.

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SKIN FLORA OF COD CHANGES AFTER WASHING AND ICING

Washing with running sea water decreases the count of bacteria in the skin of freshly-fished cod to a large extent, without changing the percentages of the various genera. After icing, on the other hand, bacterial counts increase and new types of bacteria appear. There has therefore been further contamination from the ice. ("Changes in the Skin Flora of Cod After Washing and Icing," by D. L. Georgala, J. Appl. Bacteriol., Great Britain, 1957, vol. 20, no. 1, pp. 23-29.)