

FREEZING AND COLD STORAGE OF PACIFIC NORTHWEST FISH AND SHELLFISH

Part IV - Storage Characteristics of Four Species of Salmonidae

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ABSTRACT

In storage at 6° to 16° F., steelhead trout steaks wrapped in cellophane were slightly rancid after about 90 days; pink salmon, chum salmon, and silver salmon steaks wrapped in cellophane were slightly rancid after 180 days. Silver salmon steaks wrapped in aluminum foil and stored at 6° to 16° F. gave no indication of rancidity even after 270 days.

INTRODUCTION

The changes in color and flavor of pink salmon, chum salmon, and silver salmon fillets that had been wrapped in moisture-vaporproof cellophane and held in frozen storage were studied in 1942 by Stansby and Harrison. A similar study of pink salmon steaks was made by Bucher in 1944.

As a continuation of the work of Stansby and Harrison and of Bucher, this paper reports on a study made to determine the frozen-storage characteristics--changes in odor, flavor, color, and texture--(1) of steaks of steelhead trout (*Salmo gairdnerii*), pink salmon (*Oncorhynchus gorbuscha*), chum salmon (*Oncorhynchus keta*), and silver salmon (*Oncorhynchus kisutch*) wrapped in moisture-vaporproof cellophane, and (2) of silver salmon steaks wrapped in aluminum foil.

SOURCE AND HISTORY OF THE SAMPLES

The fish used in these studies were obtained at the peak of their respective runs from lots that were typical of the species with respect to size and maturity. All of the fish were of first quality and were obtained fresh.

Steelhead Trout: The steelhead trout were caught in the Columbia River above Astoria, dressed heads on aboard the vessel, and iced ashore on the day of capture. They were purchased on the following day, iced at Astoria for transit, and re-iced in transit at Aberdeen. Two days elapsed from the time the fish were caught until they were processed and put into the Seattle freezer.

Pink Salmon: The pink salmon were part of a lot of purse seine-caught fish obtained near Kanaka Bay, San Juan Islands, Washington. They were shipped in the round to Seattle in ice, unloaded, and re-iced on shore. They were about three days out of the water before being processed and put into the freezer.

Chum Salmon: The chum salmon were taken in a gill net, probably from the mouth of the Nisqually River near Olympia, Washington, dressed heads off aboard the vessel, and trucked to Seattle un-iced on the day of capture. These chum salmon were sexually mature. One day elapsed from the time they were caught until they were processed and put into the freezer.



Figure 1 - Placing the salmon steak on the foil.

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life Service, Seattle, Wash.

Silver Salmon: The silver salmon were caught by trolling and were then dressed heads on, without gills, and stored in ice. They were about two days out of water before being processed and put into the freezer.

PREPARATION OF SAMPLES FOR STORAGE

General Procedure: In the preparation of the samples for storage, the fish were dressed, washed, and steaked.

Two series of samples were then packaged. The first, a test series, was put up to show how long the fish would keep if prepared, packaged, and stored commercially as steaks. The second, a control series, was prepared under special conditions that were thought would maintain original quality for the duration of the test period. The purpose of the control series was to provide a standard against which any loss of quality in the test series could be measured.

Dressing and Cutting the Fish for Test Samples: Fins, tails, heads, and viscera, if still present at the time of purchase, were removed, and the fish were then washed thoroughly and cut crosswise into $\frac{3}{4}$ -inch-thick steaks.

Dressing and Cutting the Fish for Controls: Fish for the control samples were dressed and cut exactly as for the test samples, with the exception that the steaks were reduced in size when necessary to fit flat in a one-half pound can.

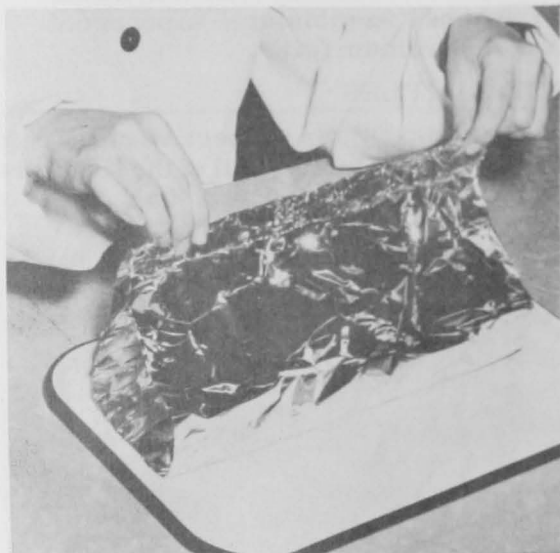


Figure 2 - Starting the drugstore fold.

was used to close the cellophane around the steaks. The wrapped steaks were then placed two-layers deep in two-piece folding waxed cartons $2\frac{1}{4} \times 7\frac{3}{4} \times 10\frac{1}{4}$ inches in size. Other test samples (individual steaks) of silver salmon were wrapped tightly in heavy aluminum foil in exactly the same manner as the samples that were wrapped in cellophane (figures 1, 2, and 3). The cartons, when filled and closed, were frozen overnight in rapidly moving air at -20° F.

Preparation of Control Samples for Storage: Because fresh fish for use as controls would not be available throughout the test period, it was necessary to use frozen controls. In the present study, the controls were prepared by one of the most effective methods available for preserving frozen fish: that is, they were vacuum-packed in hermetically sealed cans prior to being frozen. Although not always commercially practical, this method has been used by frozen-food laboratories to

Preparation of Test Samples for Storage: When the test series were planned, consideration was given to the fact that the storage life of a particular species of fish depends greatly upon the methods of preparation, packaging, and storage used. Fish can be held for a long time with minimum loss of quality if, for example, the individual fish are frozen in a block of ice and stored at a very low temperature. However, such a method is obviously not practical. What is needed is information on how long the fish will keep if prepared, packaged, and stored by ordinary commercial methods. For this reason, a practical low-cost commercial method in common use was employed, as follows: The test samples (individual steaks) of steelhead trout, pink salmon, chum salmon, and silver salmon were wrapped tightly in a single sheet of moisture-vaporproof cellophane to exclude air. The drugstore fold

prolong the time over which experimental samples will retain their original fresh qualities.

The control samples (steaks) were packed two deep in one-half pound flat cans. These cans were then hermetically sealed under 15 inches of vacuum, frozen overnight in rapidly moving air at -20° F., and finally transferred to solid fiberboard cases, which were placed in frozen storage.

STORAGE CONDITIONS

As frozen-storage facilities were not available at the laboratory, commercial facilities were used. The temperature of storage ranged from 6° to 16° F.

ORGANOLEPTIC EXAMINATION

Objective chemical and physical tests have not proved entirely successful in the determination of frozen-fish quality; organoleptic factors of palatability and appearance are usually considered better criteria. All of the samples were therefore examined organoleptically by a test panel for changes in odor, flavor, texture, and color. In each test, this panel was made up of at least eight people experienced in making organoleptic determinations. The samples were examined after 0, 90, 180, and 270 days of storage.

General Preparation of Fish for Organoleptic Examination: At each examination, about 4 pounds of cellophane- or foil-wrapped test samples and 8 cans of vacuum-packed control samples were used. All samples were thawed at room temperature in moving air from an electric fan.

Salting and Baking: Both the thawed test samples and the thawed control samples were immersed in a 6-percent salt solution for 5 minutes to bring out the natural flavor of the fish. Upon being removed from the solution, the samples were drained, baked for 20 minutes on cooky sheets in an oven set at 350° F., and immediately served to the test panel.

Organoleptic Test: After observing color changes, if any, and noting odor, flavor, and texture, each panel member rated the test sample and the control sample using the symbols VG for very good (highest quality), G for good (some loss of original quality but no indication of rancidity), F for fair (slightly rancid), P for poor (moderately rancid and barely edible), and U for unacceptable (very rancid). Numerical values of 4, 3, 2, 1, and 0 were assigned to VG, G, F, P, and U, respectively. The average of the resulting scores gave a single final numerical score that could be changed back to the equivalent alphabetical rating.

RESULTS AND DISCUSSION

The results of the organoleptic examinations appear in table 1.

Of the species studied, steelhead trout had the shortest storage life. Steaks cut from them and wrapped in cellophane were slightly rancid after 90 days of storage.

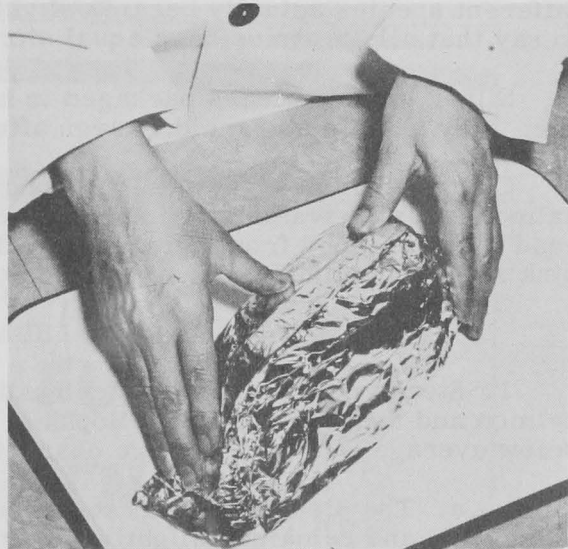


Figure 3 - Finishing the drugstore fold.

In contrast, pink, chum, and silver salmon steaks wrapped in cellophane were without any indication of rancidity after 90 days of storage and were only slightly ran-

Table 1 - Effect of Time in Frozen Storage and Method of Packaging on the Quality of Steaks from Four Species of Salmonidae

Time in Fro- zen Storage at 6° to 16° F.	Quality Rating ^{1/}								
	Steelhead Trout		Pink Salmon		Chum Salmon		Silver Salmon		
	Cellophane	Tin	Cellophane	Tin	Cellophane	Tin	Cellophane	Foil	Tin
Days									
0	VG	VG	VG	VG	G	G	VG	VG	VG
90	F	G	G	VG	G	G	G	G	VG
180	F	G	F	G	F	G	F	G	VG
270	F	G	P	G	F	G	F	G	VG

^{1/} VG = Very good (highest quality)
 G = Good (some loss of original quality but no indication of rancidity)
 F = Fair (slightly rancid)

P = Poor (moderately rancid and barely edible)
 U = Unacceptable (very rancid)

cid after 180 days. These data thus classify the storage life of frozen pink salmon, which is known to be relatively short, with that of chum and silver salmon. However, the data do not show exactly when within the 90-to-180-day period that each of the 3 different species actually became slightly rancid. For this reason, it is not possible to say that all 3 species have equal storage qualities.

Silver salmon steaks packaged in heavy aluminum foil had the longest storage life: they showed no rancidity even after 270 days.

Control Samples: Of the four species of fish packed as controls, only the chum salmon and silver salmon remained unchanged for the entire 270 days. The steelhead trout declined from very good at the beginning to good after 90 days, and the pink salmon declined from very good at the beginning to good after 180 days.

SUMMARY

1. Steaks cut from fresh steelhead trout, pink salmon, chum salmon, and silver salmon and then wrapped in cellophane and stored at 6° to 16° F. for 270 days had below average ^{1/}frozen-storage characteristics:

- a. The steelhead trout steaks were slightly rancid after 90 days and remained slightly rancid for the rest of the storage period.
- b. The pink salmon steaks were slightly rancid after 180 days and moderately rancid after 270 days.
- c. The chum salmon and the silver salmon steaks were slightly rancid after 180 days and remained slightly rancid for the rest of the storage period.

2. Steaks cut from silver salmon, wrapped in aluminum foil, and stored at 6° to 16° F. for 270 days had above average storage characteristics. These steaks showed no rancidity even at the end of the storage period.

LITERATURE CITED

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^{1/} Fish with average frozen storage characteristics can be stored for 6 months without showing any rancidity.

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