

# HOW TO COOK FROZEN FISH WITHOUT PRETHAWING

## Part I - Determination of Optimum Internal Temperature for Baked Frozen Halibut Steaks

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### CONCLUSION

The internal temperature range for baked frozen halibut steaks that was most consistently acceptable was that from 155° to 160° F. Consequently, for purposes of establishing time and temperature relationships for baking frozen halibut steaks without prethawing, this temperature range should be used as the standard for doneness.

### BACKGROUND

The growth of prepackaged foods of all kinds has been tremendous in the past few years. Keeping pace with the myriad numbers of these products--which range from dry cereal, crackers, and cookies through fresh meats and cheese to all types of fresh fruits and vegetables--is the one-pound package of frozen fish fillets and steaks. The big selling point for prepackaged foods in meal-size containers has been convenience. Whereas this has undoubtedly been an important aid in the sale of fresh items and in the sale of frozen products for which no prethawing is required, the sale of frozen fish steaks and fillets has been retarded to some extent by the lack of specific reliable instructions for cooking without prethawing.

Since no experimental work has been published on this problem, a study was undertaken at the Service's Seattle Technological Laboratory. The first objective of the study was to establish for "doneness" a standard that would be reproducible. In the past, fish has been considered done if, when tested with a fork, it flaked easily. This criterion is much too indefinite for any type of controlled laboratory experiments. Thus, a more objective method of judging doneness was needed for the present work.

A logical reference point for determining the doneness of protein foods is internal temperature. Thus, the work on meat cookery in other laboratories has been based on final internal temperature as has the work on salmon steaks by Helen Charley (1952).

The purpose of the work reported in this paper was to establish the optimum internal temperature for baked frozen halibut steaks. Baking was chosen as the cooking method because it is a standard method involving conditions that can be controlled and reproduced. Halibut steaks were chosen because halibut is one of the principal species of fish sold as frozen steaks. It is also readily available throughout the year.

In the work, two series of tests were performed: The first series was of a general nature designed to explore the various aspects of the problem and to provide training and experience for a taste panel. The second series was more specific and was designed to fix the temperature range of doneness within narrow limits.

In each series, the basic procedure consisted of baking frozen halibut steaks to various internal temperatures and having a taste panel evaluate them for palatability.

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### FIRST SERIES OF TESTS

In the first series of tests, the extreme temperature limits for doneness were tentatively established as ranging from 130°-175° F. Flavor scores were directly proportional to the rise in temperature within this range, whereas juiciness and texture scores were inversely proportional to the rise in temperature. The average scores appeared to fall into natural groupings from which four temperature ranges were selected for use in the second series of tests.

### SECOND SERIES OF TESTS

In the second series, the panel members were asked to give a judgment based on the composite effect of flavor, texture, and juiciness rather than to classify their judgments according to these individual palatability components. Enough tests were conducted so that a total of 54 judgments for each temperature range could be collected and the final scores could be analyzed statistically. The average score and the standard error were determined for the scores in each temperature range.

### EXPERIMENTAL PROCEDURE

The halibut steaks used in the tests were purchased at a local retail market. For each test, one-inch-thick steaks were sliced in succession from a single fish. Each steak was wrapped in aluminum foil and frozen until needed.

**PREPARATION FOR COOKING:** The frozen steaks were unwrapped and then brined in a solution of  $\frac{1}{2}$  cup of salt in 1 quart of water for 2 minutes, drained, and arranged on shallow tin-coated steel baking pans. Glass-covered constantan (nickel-copper alloy) thermocouples were inserted into the center of the steaks equidistant from top and bottom, with as little glass exposed as possible to prevent the conduction of heat into the steak by the glass.

**BAKING PROCEDURE:** The prepared steaks were baked in a standard household-type electric-range oven, which had been preheated to 350° F. All of the samples were placed in the oven at the same time but were removed individually as they reached the predetermined temperatures corresponding to one of the following ranges: (a) 130°-135° F., (b) 145°-150° F., (c) 155°-160° F., (d) 170°-175° F.

**TEMPERATURE RECORD:** The thermocouples inserted in the fish were attached to a temperature-recording device so that a continuous temperature record was made for each sample. The temperatures of all steaks were below freezing (26°-29° F.) when the steaks were placed in the oven.

**PRESENTATION OF SAMPLE:** As the steaks were taken from the oven, after being baked, the skin and bones were removed, and the meat was broken up enough so that it could be placed in 1,000-milliliter beakers. The beakers were coded, covered with aluminum foil, and held in a 130° F. oven until all 4 samples were ready. The fish was then shredded and mixed thoroughly in the beakers to insure a homogeneous sample. Individual samples were removed to coded warmed 50-milliliter beakers, and each panel member was presented with a tray of 4 of the coded beakers corresponding to the four temperature ranges. The panel members were asked to arrange the samples in order of preference.

**GRADING OF SAMPLES:** The following arbitrary numerical scores were assigned according to the order of choice:

1st choice - 40 points  
2nd " - 30 "

3rd choice - 20 points  
4th " - 10 "

In the case of a tie, the points each sample would have received, if one sample had been preferred over the other, were added together and divided by two. Each sample was then given this score.

**TASTE PANEL:** The taste panel was drawn from a group of 10 members of whom 5 or 6 were available for each test. The members were experienced by preliminary work and could quite consistently distinguish doneness in samples differing by only 10° F. in internal temperature.

### RESULTS

The average score and standard error found for each temperature range are presented in table 1.

Internal Temperature of Steaks	Palatability Score of Steaks <sup>1/</sup>	Standard Error of Palatability Score
Degree Fahrenheit	Arbitrary Points	Arbitrary Points
a. 130 - 135	20.1	±1.59
b. 145 - 150	26.9	±1.41
c. 155 - 160	27.6	±1.09
d. 170 - 175	25.6	±1.69

<sup>1/</sup> Each score is the average of 54 judgments.

Range (a)--130°-135° F.--had the lowest average score, indicating that it was the least satisfactory of the temperature ranges used.

Range (d)--170°-175° F.--had a higher average score than range (a), but the standard error was larger, indicating a marked disagreement among the tasters in their judgment of samples in this temperature range. Tasters who had been found in series I to be influenced largely by flavor graded these samples high, whereas those who had been found more sensitive to texture and juiciness graded them very low.

Ranges (b)--145°-150° F.--and (c)--155°-160° F.--had average scores within 0.7 of a point of each other, but range (c) had a lower standard error. Range (c) also had the highest average score of the four ranges. These facts indicate that there was more general agreement between the tasters on this temperature range than on any of the other three.

### LITERATURE CITED

Charley, Helen

1952. Effects of Internal Temperature and of Oven Temperature on the Cooking Losses and the Palatability of Baked Salmon Steaks. Food Research, vol. 17, no. 2 (March-April), pp. 136-143.



### DO YOU KNOW

That a series of experiments to test improved methods of carrying shrimp in crushed ice disclosed that no measurable differences in quality could be detected among the shrimp held in ice with 3 different sizes of particles: "snow," "rickey," or "flake."

--Food Field Reporter, December 14, 1953