DETERMINATION OF COOK DRIP IN PACIFIC OCEAN PERCH (SEBASTODES ALUTUS) AND PACIFIC OYSTERS (OSTREA GIGAS) BY USE OF A NEW METHOD

INTRODUCTION

One of the characteristic changes that animal-protein tissues exhibit when they leave the natural or living state is the loss of ability to hold all of the water that is present in the living tissue. An example of the resulting fluid exudation from meat, of considerable practical importance, is that which occurs during the thawing of frozen meat, fish, and seafood. For instance, frozen oysters show a considerable loss of fluid when they are thawed.

In the food industry, it is customary to refer to the fluid that exudes from protein tissues as "drip." If the drip separates without the aid of any external force except gravity, it is called "free drip." If pressure is applied to the tissue, the expressed fluid is called "press drip." Similarly, if the tissue is heated, the fluid that collects is termed "cook drip."

Over a period of several years the Seattle Fishery Technological Laboratory has conducted experimental work on drip in fish and seafoods. One of the main objects of this work has been to establish a reliable method for determining cook drip. The importance of such a method lies in the fact that, through its use, one can study the influence of such factors as freshness, cold-storage time, and prethawing on the amount of cook drip produced from fresh and frozen fish and shellfish. Eventually, when more is known about the factors affecting drip production, it may be possible to develop ways of handling foods so as to minimize losses from this source. Moreover, infomation about drip production may lead to a better understanding of the changes taking place in the cellular proteins that make up the primary structure of fish.

In the establishment of the method for determining cooked drip, the following principles were considered:

(1) The method must give reproducible results.

(2) The cooking procedure used should be similar to one used in actual practice.

(3) The cooking should be done in a medium maintained at constant temperature.

(4) The fresh, frozen, and thawed samples should all be cooked to the same internal temperature.

This paper describes the method developed at the Seattle Laboratory for the determination of cook drip. Also given are the results obtained by use of the method on oyster and Pacific ocean perch samples.

METHOD FOR DETERMINATION OF COOK DRIP IN FISH AND SHELLFISH

The samples are placed in flat half-pound tins containing small wire racks made from $\frac{1}{2}$-inch mesh screen. (These racks support the samples above the bottom of the can.)

In the case of fish, the samples of fillets are cut crosswise into pieces approximately 1-inch long. These cross-section cuts are then packed two or three to a can. In the case of a seafood such as oysters, two or three whole specimens, depending on size, are packed per can. The cans are weighed before and after the samples are added so that the weight of the sample in each can is known.

Lids that have a $1\frac{3}{8}$-inch hole cut in them are then seamed onto the cans, and a No. 8 2-hole rubber stopper is tightly fitted in the hole in the lid. A thermometer is run through one hole of the stopper so that its bulb is completely immersed in the sample. An 8-inch length of glass tubing is placed in the other hole to prevent evaporative losses and to maintain atmospheric pressure within the can during the cooking process.1/

The weight of the can plus contents is obtained, and the sample is then cooked by immersing the can in boiling water until the internal temperature of the sample reaches 150° F.2/ After the cooking is completed, the can is cooled in cold water and then opened. The cook drip that has collected in the bottom of the can is drained off. The weight of the can plus contents is then taken. From the loss in weight of the sample, the percentage of cook drip is calculated. Six replicate determinations are usually run in each test.

APPLICATION OF THE METHOD AND DISCUSSION OF THE RESULTS

The method was used to determine the amount of cook drip in one lot of frozen Pacific ocean perch samples, half of which were prethawed prior to being cooked

Table 1 - Comparison of the Amounts of Cook Drip from Samples of Frozen Rockfish Fillets Cooked Without Being Prethawed and Cooked After Being Thawed

Sample	Drip from Fillets Cooked Without Being Prethawed	Sample	Drip from Fillets Cooked After Being Prethawed 1/
Number	Percent	Number	Percent
1	29.7	7	25.5
2	30.9	8	25.9
3	33.7	9	25.3
4	29.9	10	25.1
5	29.7	11	25.4
6	30.5	12	25.2
Mean Value	30.7	Mean Value	25.4
Standard Deviation	1.4	Standard Deviation	0.3

1/ The fillets did not yield a measurable amount of thaw drip.

and half of which were not. The results (table 1) indicate that the method has a satisfactory degree of precision.

The purpose of this work was to find out how the amount of cook drip obtained from frozen fish cooked without prethawing compares with that obtained from fro-

1/ If the amount of free drip from the sample is to be determined, the stopper is removed from the can after the necessary drainage time has elapsed. The fluid that has collected below the wire rack is removed through a pipet. The percentage of free drip can be computed from the difference in the weight before and after the removal of the drip.

2/ A temperature of 150° F. is chosen because it is considered to produce the proper degree of heat treatment for adequate cooking of the fish.

zen fish cooked after prethawing. It was found that, with the particular sample of rockfish fillets used, the prethawing resulted in 5 percent less cook drip (table 1).

Table 2 - Amounts of Cook Drip from Samples of Medium Pacific Oysters Held in Storage at 34° F.

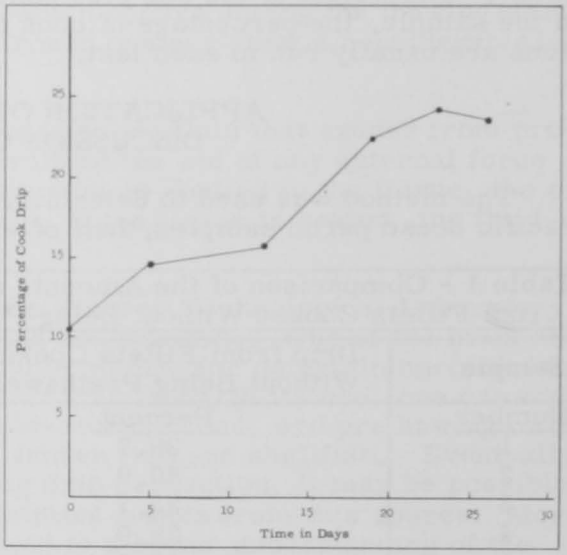
Storage Time	Cook Drip
Days	Percent
0	1/ 10.3 (10.5)
5	14.7
12	16.1
19	22.7
21	(23.3)
23	24.4
26	23.7

1/ The cook-drip values in brackets were obtained on medium Pacific oysters from a different source and during another season of the year.

One explanation of this finding can be deduced from the ice-crystal theory that has been advanced by a number of workers. This theory suggests that ice crystals are formed within the cells in frozen foods and that the size of the crystals depends on the temperature and quickness with which the foods are frozen. It follows that, during thawing, the water from the ice crystals may be partially reabsorbed or fixed by the cellular proteins. However, if thawing takes place during cooking, then the proteins may be denatured before much reabsorption of water can take place. As a result, more water would be liberated.

A number of experiments were also carried out to study the effects of freshness and of cold-storage time on the amount of cook drip produced by medium Pacific oysters.

In the first experiment, oysters were taken directly from the shell and stored at 34° F. Samples were removed after 0, 5, 12, 19, 23, and 26 days. After 12 days the samples started to develop a characteristic sour odor. The amounts of cook drip obtained in this experiment are given in table 2 and in graph 1.



As can be seen from the data, there was a sharp increase in the amount of cook drip produced by these oysters after 12 to 19 days in refrigerated storage. This time interval corresponds closely to that at which the sour spoilage odor developed. It is an interesting but unconfirmed indication that there may be a relationship between this type of spoilage and high levels of cook drip.

The study on fresh oysters indicates that it may be possible to estimate the age of a commercial pack of oysters by the cook-drip method. Thus, the method may be of value for quality-control purposes. It was observed, however, that if the oysters were excessively broken or ruptured, the cook-drip values showed a considerable increase. Consequently, if cook drip was used for oyster-freshness evaluation, it shoud be used primarily with whole oysters, or a correction factor should be worked out for the presence of cut, broken, or ruptured oysters.

In a second series of experiments on Pacific oysters of medium size, the samples were canned and placed in storage at 0° F. within 5 hours after being shucked. Samples were removed after 36 hours' storage and every week therafter for 4 weeks. The determination of cook drip was carried out on the samples without prethawing. The results show that the amount of cook drip from freshly shucked and frozen oysters increased very sharply from 10 percent in the fresh oysters (table 2) to 22 percent in oysters after 36 hours in frozen storage (table 3). The cook drip then increased slightly to 24 percent after one week in frozen storage and remained constant for the remainder of the month. From these tests it appears that cook-drip

loss from frozen oysters is correlated with some change that occurs very rapidly after the oysters have been frozen. An explanation may lie in the fact that the principal tissue protein, myosin, is quickly denatured by freezing, as has been repeatedly shown by other workers.

Table 3 - Amounts of Cook Drip from Samples of Frozen Medium Pacific Oysters Cooked Without Pre-Thawing After Storage at 0° F. for Different Lengths of Time

Storage Time	Cook Drip
	Percent
36 hrs.	22.1
1 week	24.5
2 weeks	24.1
3 "	24.6
4 "	23.8

A somewhat different experiment on medium-sized Pacific oysters was designed to test the effect of freezing live oysters-in-the-shell on the amount of cook drip produced. The oysters were frozen 10 to a lot and then double-wrapped in kraft freezer paper. The packages were removed after 6 months' storage in still air at 0° F., and the oysters were thawed overnight in a cold room at 34° F. They were then shucked, and the cook-drip value, which was determined as previously described, was found to be 15 percent. There was some dehydration, but it could probably be prevented by better packaging. (This work suggests that frozen oysters-in-the-shell might have possibilities as a specialty product if, with additional experimental work, a satisfactory technique were developed.)

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TECHNICAL NOTE NO. 31 - WEIGHT RANGE, PROXIMATE COMPOSITION, AND THIAMINASE CONTENT OF FISH TAKEN IN SHALLOW-WATER TRAWLING IN NORTHERN GULF OF MEXICO

INTRODUCTION

A few years ago a plant was opened in Pascagoula, Miss., for the production of canned cat food. At that time it was planned to utilize the small fish taken in shrimp-trawling operations. These fish are the so-called shrimp-trawl trash fish, which are otherwise discarded overboard and wasted.

The cat food proved to be a popular product. The size of the plant was expanded, and another cat-food plant was built in the area. It was soon found that the shrimp-trawl trash fish was too irregular a source and of insufficient volume to supply the expanded demand. At the present time the fish are therefore being supplied by a separate trawl fishery conducted by perhaps 20 to 40 vessels, mostly small former shrimp trawlers but including some larger vessels from as far away as Gloucester, Mass. Most of the fishing is conducted near port, and the trips are usually short, not more than two days. Nonetheless, with the high air and water temperatures of the Gulf, it is necessary to ice the fish fairly heavily.

A considerable number of species are found in the catch. Skates, crabs, and shell are culled out on the boat deck and discarded. The few fish of marketable size and desired species as well as the few shrimp taken are removed and sold sep-

arately. A second more careful cull takes place in the canning plant as the catch is washed and carried up a mesh conveyor belt.

There is little published information on the species most prevalent in the catch and on whether they show any pattern of seasonal variation; even less is known of their chemical composition, including their thiaminase content. Requests for information of this kind have been received, since a possible market for the fish might exist in the North Central states. Fur farmers in that area are finding it increasingly difficult to obtain the horse meat which has been the staple animal mink-food in past years, and supplies of fresh-water fish are inadequate and expensive. The following work was therefore undertaken primarily to furnish data needed in the utilization of the fish for fur-animal feed.

EXPERIMENTAL

The proximate composition and weight range was determined for one lot composed of 10 species of Gulf trawl fish taken in March 1954.[1/] A second lot was caught at a depth of 18 fathoms in May 1954 and comprised 19 species, some of which make up a very minor portion of the normal catch. Nine species of the first lot were also found in the second. In both lots, the croaker was the most common species, making up about 75 percent of the catch. Spot, scup (porgy), sea robin, and sea catfish made up much of the remaining 25 percent. However, a breakdown of any given lot according to percentage by weight of each species is of little significance, owing to the variability in the number of minor species from one trawl to the next.

Data on the second lot of Gulf trawl fish are given in table 1. All of the fish sampled were quite small, most weighing less than 3 ounces and none weighing as

Table 1 - Data on Shallow-Water-Trawl Fish of Northern Gulf of Mexico Caught in May 1954

Common Name	Scientific Name	Number of Fish in Sample	Weight of Fish			Proximate Composition				Thiaminase[1/]
			Minimum	Average	Maximum	Moisture	Protein	Fat	Ash	
			(Grams)			(Percent)				
Butterfish	Poronotus triacanthus	44	38	54	76	73.4	16.8	8.0	2.7	Low level
Croaker	Micropogon undulatus	33	47	71	91	76.6	15.8	3.2	6.2	None
Flatfish	Pleuronectidae spp.	43	20	58	303	76.2	18.4	1.4	4.6	Not tested
Hake	Urophycis spp.	39	20	40	167	80.8	16.2	0.8	3.9	None
Lizardfish	Snyodus foetens	25	41	117	207	77.5	18.6	0.8	3.9	None
Moray eel	Gymnothorax ocellatus	4	140	162	185	79.6	17.3	1.5	3.1	High level
Policefish	Anchoa hepsetus	119	12	15	20	78.1	17.4	2.6	2.9	Not tested
Scup (porgy)	Stenotomus aculeatus	42	23	54	122	70.6	17.8	3.1	8.9	None
Razor belly	Harengula pensacolae	41	28	53	73	67.8	20.0	7.1	6.4	High level
Sea bass	Centopristes ocyurus	11	17	29	43	76.3	17.3	1.5	5.8	Not tested
Sea catfish	Galeichthys felis	30	57	79	190	72.7	17.4	4.3	6.4	None
Sea robin	Prionotus spp.	35	36	67	307	77.0	16.4	1.2	6.2	None
Sergeant major	Nautopaedium porosissimum	34	14	28	49	81.2	14.6	2.1	2.6	Not tested
Silver eel or cutlass fish	Trichiurus lepturus	45	18	56	82	78.8	16.8	3.6	2.3	None
Snapper (Pensacola red)	Lutianus blackfordi	9	20	32	58	77.4	17.6	1.0	5.4	Not tested
Spadefish	Chaetodipterus faber	3	58	76	100	73.8	16.8	6.2	3.2	Not tested
Spot	Leiostomus xanthurus	27	73	90	112	72.0	16.5	8.3	3.9	None
Squid	Loligo brevis	26	15	41	76	84.0	13.5	1.5	1.0	None
White trout	Cynscion avenarius	26	77	109	154	79.3	16.4	1.8	2.7	None

1/ The thiaminase assays were made by Food Research Laboratories, Inc., Long Island City, N. Y.

much as a pound. (There are 454 grams in a pound; 28 grams in an ounce). All analyses were carried out on a ground composite of the whole raw fish, since whole or ground raw fish is the form usually fed to fur animals.

Protein content of this lot of fish ranged from 13.5 percent (squid) to 20.0 percent (razor belly). The oil content was quite variable ranging from 0.8 percent (hake and lizardfish) to 8.3 percent (spot). Eleven of the species contained less than 3 percent oil, 4 species from 3 to 5 percent, and only 4 species contained more than 5 percent. The ash content was also variable, depending mainly on the ratio of bony skeleton to meat, and ranged from 1.0 percent (squid) to 8.9 percent (scup).

Thirteen of the species obtained in the second lot of trawl fish were assayed for the enzyme called thiaminase. Knowledge of the presence of thiaminase is important

1/ These data were reported in Commercial Fisheries Review, vol. 16, no. 6, June 1954.

because an appreciable amount of this enzyme in a small proportion of the fish in a mixed lot can destroy thiamine present in species of fish not containing the enzyme if the fish are ground or eaten together. Similarly, thiaminase may also destroy the thiamine in other constituents in the diet. It should be emphasized, however, that thiaminase is destroyed by heat, so that none would be found in canned cat food, which is thoroughly heat processed.

The thiaminase assay involves the use of two aliquots of the fish. One aliquot is left fresh; the other is heat treated in order to destroy any thiaminase present. One hundred micrograms of thiamine is then added to both aliquots, and after a short period of incubation, the thiamine content in each aliquot is determined. If both assay the same, the fish contains no thiaminase; but if reduced amounts of thiamine are recovered from the uncooked aliquot, low levels of thiaminase are present, and if no thiamine is recovered, high levels are present. As can be seen in table 1, a high level of thiaminase was found in the razor belly and moray eel. These species should therefore be culled out if the catch is to be used as fur-animal feed.

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BROILED HALIBUT STEAKS

Halibut steaks may be cooked in many different ways, including the following favorite of U. S. Fish and Wildlife Service home economists.

2 pounds halibut steaks
1 teaspoon salt
Dash pepper
$\frac{1}{4}$ cup butter or other fat, melted

Cut fish into serving-size portions. Sprinkle both sides with salt and pepper. Place fish on a preheated greased broiler pan about two inches from the heat and brush with butter. Broil 5 to 8 minutes or until slightly brown. Baste with butter and turn carefully. Brush other side with butter and broil 5 to 8 minutes more or until fish flakes easily when tested with a fork. Garnish and serve immediately. Serves 6.