KEEPING QUALITY OF CHILLED DUNGENESS CRAB MEAT IN HERMETICALLY-SEALED METAL CONTAINERS

Investigations on the keeping quality of chilled Dungeness crab meat are being conducted in an attempt to evaluate bacterial spoilage by using organoleptic examinations, total bacterial count, and certain chemical tests. Such studies of both fresh and previously frozen non-heat processed crab meat held at 40° F. will provide helpful data for preparation of recommendations to the industry and for the establishment of government purchase specifications.

Table 1 - Comparison of Storage Life and Bacterial Count of Chilled Dungeness Crab Meat Held at 40° F.

Series	Type of Pack 1/	Initial Bacterial Plate Count 2/	Acceptable Storage Life at 40° F.	Bacterial Plate Count on Minimum 3/ Acceptability Date
		Bacteria/gm	Days	Bacteria/gm
1A	No vacuum. Held at 40° F. during approximately 20-day examination period.	1.7×10^5	5	1.4×10^7
1B	High vacuum (20 in.). Held at 40° F. during approximately 20-day examination period.	1.7×10^5	7	6.4×10^7
2	Medium vacuum (10 in.). Held at 40° F. during approximately 20-day examination period.	0.92×10^5	9	19×10^7
3	Medium vacuum (10 in.). Frozen storage for 5 weeks then held at 40° F. for approximately 20-day examination period.	8.7×10^5	7	5.0×10^7 (estimated)
4	No vacuum. Frozen storage for 5 weeks then held at 40° F. for approximately 20-day examination period.	180×10^5	2	1.5×10^7

1/ All samples were packed in double-seamed 6½ oz. C-enamel cans.
2/ Total bacteria count determined by method of Elliot, R. P., Commercial Fisheries Review, vol. 10, no. 11, November 1948, pp. 11-25.
3/ Date on which meat was still organoleptically acceptable prior to date on which meat became unacceptable.

Initial experimental work (Commercial Fisheries Review, Vol. 16, No. 11, November 1954, pp. 20-21) indicated that the storage life of chilled crab meat packaged dry in hermetically-sealed metal containers and stored at 40° F. was approximately 5 to 7 days. Three additional series of crab meat, packaged and stored under similar conditions, have been examined. The storage life of these series was 2, 7, and 9 days. There seems to be little correlation between the acceptable storage life (table 1) and the bacterial count of the crab meat on the day of minimum acceptability, as determined organoleptically. The degree of initial bacterial contamination seemed to follow a more definite pattern (table 1). The series with the lowest initial count had the longest storage life whereas the one with the highest initial count had the shortest storage life. This indicates simply that the cleanest crab meat keeps longer, which is already a well-known fact.

EFFECT OF BRINE FLOTATION

In many of the Pacific Coast crab-processing plants the picked crab meat is passed through a strong brine for the purpose of removing bits of adhering shell or other debris. A short study was made of the effect of this brining on the bacterial load of the crab meat. Samples were obtained at various intervals during a one-day period, prior to and after the brine wash. The bacterial counts show (table 2) that the load is reduced significantly after brining. This would seem to indicate that the strong salt solution is effective in washing away large numbers of bacteria as well as in removing the debris.

Table 2-Effect of Brining on Bacterial Load of Crab Meat

Time of Collection	Bacteria in Leg Meat		Bacteria in Body Meat	
	Before Brining	After Brining	Before Brining	After Brining
	Bacteria/gram	Bacteria/gram	Bacteria/gram	Bacteria/gram
8:00 A. M.	238,000	111,000	123,000	193,000
1:00 A. M.	1,070,000	266,000	4,180,000	170,000
4:00 P. M.	570,000	250,000	2,190,000	360,000

Note: Total bacteria count determined by method of Elliott, R. P., Commercial Fisheries Review, vol. 10, no.11, November 1948, pp. 11-25.

KEEPING QUALITY OF FRESH CRAB MEAT

In order to evaluate the keeping quality of the crab meat, it was necessary to rely on organoleptic examinations, since there are no common objective standards of acceptability based on either the bacteriological or chemical analyses. In the foregoing tests, odor and appearance were used to evaluate the quality of the product. The odor of fresh Dungeness crab meat, as it becomes less desirable, changes from a sweet crab odor to almost no odor, then to a strong crab odor which is still just acceptable. Finally when the odor becomes definitely tainted, unpleasant, and repugnant, it is judged unacceptable. In appearance, the moist, white, eye-appealing fresh meat becomes yellowish or gray as adverse changes occur.

Three series of tests have been completed in which organoleptic, bacteriological, and chemical examinations were made on fresh crab meat. The chemical examination included the determination of pH, total volatile nitrogen, and volatile reducing substances. The samples were obtained on different days from the same packing plant, packed in hermetically-sealed cans, held at 40° F. for about a 20-day period, and examined at frequent intervals. All show a similar pattern of adverse quality change. The bacterial counts rose sharply within the first few days and then leveled off for the remainder of the storage time. The pH values were erratic and showed no definite trend. The values for volatile base and volatile reducing substances showed a gradual upward trend until they reached the point at which the meat became unacceptable. At this point the values showed a rather sharp jump which was too late to be of value in indicating approaching spoilage. No determination to date, either bacterial or chemical, has been found which will in-

dicate imminent spoilage before it is obvious by organoleptic examination. Studies are continuing and include the effect of freezing and short-term storage at 0° F. on the keeping quality of the thawed meat at 40° F.

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STUDY OF PHARMACEUTICAL AND OTHER INDUSTRIAL PRODUCTS FROM SALMON EGGS

Over 6 million pounds of potential fish oil were discarded as offal from Alaska salmon canneries this year. This loss of over a third of a million dollars in possible income from the oil alone is primarily due to the isolated location of the canneries, the short canning season, the highly perishable nature of the salmon waste, and the relatively low price brought by the crude fish oil.

Crude fish oil finds keen competition on the market from the tallow of the meat-processing industry and from cottonseed, soybean, and other vegetable oils. Prices of crude fish oils depend on those commanded by tallow and vegetable oils.

Previous investigations have shown that fish oils have special properties which could give them a decided marketing edge. Fish oils contain a high proportion of long-chain highly-unsaturated fatty acids. The fatty acids of salmon-egg oil, particularly, are very highly unsaturated. These highly-unsaturated fatty acids may offer unique possibilities as chemical building blocks for the preparation of commercial chemical products. Recent work at the Ketchikan, Alaska, laboratory has been directed toward determining the composition of the oil of pink-salmon (Oncorhynchus gorbuscha) eggs to provide the basic data for evaluating the raw material.

EXPERIMENTAL PROCEDURES

Pink salmon eggs were collected from the "iron chink" of a local cannery during regular commercial operations. The eggs were well developed but still in a tight skein, between 2 and 3 in the maturity scale of Davidson and Shostrom (1936). Oil was separated from the eggs using the warm-brine technique of Sinnhuber (1943). The ground eggs were mixed with warm brine, and the oil phase was allowed to separate then decanted and clarified by centrifuging.

The oil was converted to the methyl esters of the fatty acids by direct methanolysis using the procedure of Winter and Nunn (1950). Crystallization of the methyl esters from acetone at low temperatures yielded fractions of the fatty acid methyl esters of varying degrees of unsaturation. These fractions were vacuum-distilled in a packed column and the cuts from the distillation were analyzed for iodine value and saponification equivalent. From these data the fatty-acid distribution in the oil was calculated using the method of Hilditch (1941).

RESULTS

The component fatty acids of the brine-extracted salmon-egg oil are given in the table. The component acids of other competitive oils are also listed for comparison.

The pink-salmon eggs contained 13.2 percent lipid, determined by the acid hydrolysis method. Approximately $\frac{1}{3}$ of this lipid was separated as oil using the dilute-brine method. The extracted oil contained all of the coloring matter and was

Table 1-Component Fatty Acids of Several Oils

Fatty Acid	Pink Salmon Egg Oil	Menhaden Oil 1/	Tallow (Ox) 1/	Cottonseed Oil 1/	Soybean Oil 2/
	(Percent by Weight)				
C_{14} saturate	1.8	6.0	3.0	3.0	Trace
C_{14} monounsaturate	0.1	-	-	-	-
C_{16} saturate	8.3	16.0	29.2	20.0	9.7
C_{16} monounsaturate	5.1	15.5	2.7	-	0.4
C_{18} saturate	1.9	1.5	21.0	1.0	2.4
C_{18} monounsaturate	10.5	-	41.1	30.0	29.7
C_{18} higher unsaturate	20.8 (4.4H)	30.0 (4.0H)	1.8 (4.0H)	45.0 (4.0H)	56.9 (4.2H)
C_{20} saturate	-	-	0.4	1.0	0.9
C_{20} unsaturate	31.1 (7.3H)	19.0 (10.0H)	0.2	-	-
C_{22} unsaturate	14.7 (11.8H)	12.0 (10.0H)			
C_{24} unsaturate	0.2				
Unresolved	5.5		0.6		
Total	100.0	100.0	100.0	100.0	100.0

1/ Hilditch (1941) 2/ McLeod (1951)

Note: The numbers in parenthesis are a measure of the unsaturation and indicate the atoms of hydrogen required to completely saturate the fatty acids.

primarily the free-oil droplet in the egg. The oil contained less than 0.005 percent nitrogen. The yield on methanolysis was 102 percent.

DISCUSSION

The component fatty acids in the free oil in pink-salmon eggs contained a large percentage of fatty acids with 20 and 22 carbon atoms. These long-chain fatty acids were highly unsaturated, containing 3 to 6 double bonds. The low nitrogen content and high yield on methanolysis indicate the oil was primarily a fatty-acid triglyceride. The free oil, about $\frac{1}{3}$ of the total lipid in the egg, was easily extracted by this simple process: the ground eggs are mixed with warm brine and the oil phase allowed to separate then decanted and clarified by centrifuging.

The fatty acid distribution in the total lipid of the salmon eggs is currently being determined.

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METABOLISM TRIAL TO DETERMINE COMPARATIVE NUTRITIVE VALUE OF FISH AND MEAT

On the Sunday evening (November 21, 1954) before Thanksgiving Day, 10 volunteer students on experiment ate their last test meal for this metabolism trial to determine the comparative nutritive value of fish and meat. All of them indicated they felt excellent after a test period of $7\frac{1}{2}$ weeks.

Prof. Pela Braucher, Head of the Department of Foods and Nutrition, College of Home Economics, University of Maryland, reported that the conditions of the test were much more rigidly controlled than in those of previous years. Three daily menus were devised which allowed only 10 grams of protein daily. This is about half as much protein as is contained in a single serving portion of fish or one-fifth the protein suggested by the National Research Council in its recommended daily allowances. These three menus were offered in rotation as the basal diet during the entire period. For breakfast the girls received fruit juice, dry cereal, heavy cream, bread, spread, and sugar. For lunch they ate soup or bouillon, saltines, fruit with maple syrup, gingerbread or date bar. For dinner they had Spanish rice and mushrooms and one vegetable, or bread and two other vegetables, fruit, heavy cream, and sugar. They also received daily a vitamin pill, a calcium phosphate product, and enough soft drinks or other low protein snacks to maintain their weight.

The last test-meal dinner meeting of the 10 volunteer students cooperating in a metabolism trial to determine the comparative value of fish and meat.

During nearly the first two weeks the girls did not get any fish or beef. The idea was to have their bodies supply the needed protein until they were in negative nitrogen balance. After they reached this stage half of the girls received at dinner an allowance of baked haddock and the other half an allowance of roasted sirloin of beef. The amount allowed was increased step-wise by about 10-gram portions of protein at 6- to 9-day intervals so as to determine the least amount of fish or meat that would satisfy the daily need for protein. This would be the amount that would stop the use of body protein for physiological purposes. Also every two weeks a blood sample was taken and analyzed for hemoglobin, red blood cell count, plasma protein content, and a few other indicators of metabolic status. A study was also started this year to determine if the rate of growth of fingernails was a good index of nutritional status. All of the girls had their fingernails photographed at three-day intervals under very exacting conditions. The rate of growth of the nails will then be correlated with analytical data on protein utilization for each girl and thus determine the value of the method.

The girls ate their meals with relish although at times during the early period of the trial they were almost too hungry to want to continue. When fish and meat were increased to at least a daily serving portion, the girls felt better and the extreme hunger subsided. They then enjoyed their meals and were satisfied to remain on test.

No information on data or conclusions are possible at this time since the metabolism trial was carried out so recently. There are many chemical determinations to be made that will take a long time to complete.

This metabolism trial was a part of the cooperative work of the University of Maryland and the Fishery Technological Laboratory, U. S. Fish and Wildlife Service. It was financed by funds supplied by the Maryland Agricultural Experimental Station, Bankhead-Jones Act funds distributed by the Committee of Northeast Regional Technical Workers in Home Economics, and the U.S. Fish and Wildlife Service.

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INTERIM FEDERAL SPECIFICATIONS FOR SHRIMP ISSUED

The Interim Federal specifications for Shrimp: Canned, and for Shrimp: Raw and Cooked, Chilled and Frozen were issued by the General Services Administration. These Interim Specifications were developed by the Technological Section of the U. S. Fish and Wildlife Service and the Quartermaster Food and Container Institute. Their use by all Federal agencies is recommended and they are authorized by GSA as valid waivers to Federal Specifications PP-S-311 and PP-S-316, respectively. These specifications will be converted to Federal Specifications after further coordination with industry and other Federal agencies.

BROILED BOSTON SCROD IS EASY TO PREPARE

Broiled Boston Scrod--as traditional with Bostonians as baked beans on Saturday night--is an easy-to-prepare fish dish which will please anyone who enjoys good food.

As featured in Boston's most famous eating places, scrod is simply small haddock fillets. Small haddock fillets, which average two or three fillets to a pound, are in particularly good supply and represent an economical and appetizing buy.

Here is a recipe for "Broiled Boston Scrod" recommended by the home economists of the Fish and Wildlife Service.

BROILED HADDOCK FILLETS

2 pounds haddock fillets
¼ cup butter or other fat, melted
1 teaspoon salt
Dash pepper

Sprinkle fillets with salt and pepper. Place on a preheated, greased, broiler pan about two inches from the heat, skin side down. Brush fillets with butter. Broil 5 to 8 minutes or until fish flakes easily when tested with a fork. Remove carefully to a hot platter, garnish, and serve immediately, plain or with a sauce. Serves 6.