TOUGHENING OF FROZEN CRAB MEAT CAN BE RETARDED

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ABSTRACT

Crab meat hermetically sealed in a partial vacuum retains its original tenderness, color, and flavor in frozen storage more effectively than crab meat sealed in moisture-vapor-resistant cellophane or packed in friction-top tins. In short, toughening and other deleterious effects can be materially retarded, in fact almost prevented, by the partial-vacuum packaging. The hermetically sealed, partial-vacuum package may be effective for one of two reasons or both: It excludes atmospheric oxygen and reduces the amount of oxygen present in the package at the time of sealing, and it prevents moisture losses that may be significant, even though small.

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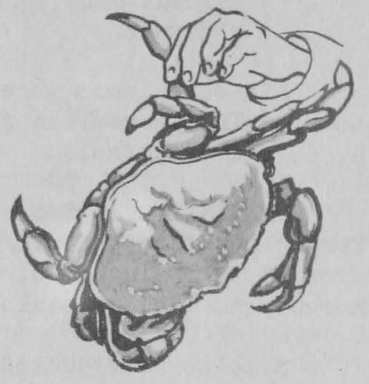
Fresh-picked Dungeness crab meat possesses a pleasing aroma, delicate flavor, attractive appearance, and a very desirable texture. Because of the seasonal nature of the crab fishery, the fresh product does not appear on the market in uniform quantities throughout the year. During the winter and spring months, when the catch of crab is large, some method of preservation must be utilized. The fresh characteristics of crab meat are not lost in preservation by freezing; therefore, the frozen product commands a better price than canned crab meat, and freezing is more extensively used.



Unfortunately, Dungeness crab meat does not retain its original quality for any length of time when placed in frozen storage. Within a relatively short storage period, it begins to lose its flaky texture and becomes increasingly tough. A gradual loss of desirable flavor and color accompanies this toughening process. The following work was planned as a means of studying factors controlling the amount of toughening and other changes that take place during storage.

EXPERIMENTAL PROCEDURE: Live Dungeness crabs in sufficient quantity to provide a supply of fresh-picked crab meat for this experiment were butchered to remove the viscera and all inedible portions, washed in running fresh water, cooked in flowing steam for 12½ minutes at 212° F., and cooled in a spray of cold water. Staff members assisted in picking the crab meat.

Half-pint waxed cartons and half-pound flat tin cans were used as containers for the crab meat. Heat-sealed moisture-vapor-resistant cellophane bags were used to line the cartons, and parchment paper was used to line the tin cans. An equal amount of leg meat and body meat totaling 7 ounces net weight was placed in each container. The cartons were merely closed; the cans were double seamed under 25 inches of vacuum. Note exception (b) below:

Crab meat was packed in the following containers without liquid:

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(a) Half-pint, cylindrical (heavily waxed) cartons containing a heat-sealed, moisture-vapor-resistant cellophane bag.

(b) Half-pound, flat tin cans, seamed on the first operation roll only, to simulate the friction-top tin can.

(c) Half-pound, flat tin cans.

Crab meat was packed in the following containers with liquid as indicated:

(d) Half-pound, flat tin cans, product packed in water to cover.

(e) Half-pound, flat tin cans, product packed in 1 percent salt* brine to cover.

(f) Half-pound, flat tin cans, product packed in 2 percent salt* brine to cover.

(g) Half-pound, flat tin cans, product packed in 3 percent salt* brine to cover.

(h) Half-pound, flat tin cans, product packed in 4 percent salt* brine to cover.

All containers were allowed to remain in the sharp freezer at 0° F. for 48 hours. They were then placed in storage at +5° F. for subsequent examination at 3, 6, and 9 months.

EXAMINATION: Two packages of each code were removed from storage and thawed for 1½ hours in tap water at room temperature before being opened. Vacuums ranged from 15 to 19 inches of mercury in the liquid packs and from 21 to 22 inches of mercury in the dry packs.

Samples were judged organoleptically by members of the staff for color and flavor. Tenderness was measured on the tenderometer developed by Shockey, McKee, and Hamm (1944) and originally designed for use in measuring the tenderness of reconstituted dehydrated fish.

Changes in Tenderness: Tenderness is one of the qualities of frozen crab meat most subject to change. It is the quality which lends itself to mechanical measurement on the tenderometer. By use of this instrument, values of tenderness were obtained and recorded in Table 1.

Table 1 - Tenderometer Values of Crab Meat[1/]

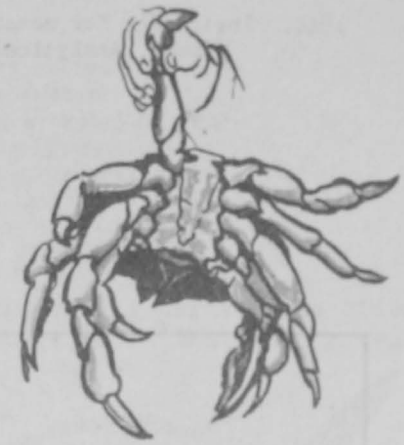
Sample	Container	Seal	Added Liquid	STORAGE PERIOD AT +5° F.								
				3 months			6 months			9 months		
				Leg	Body	Av.	Leg	Body	Av.	Leg	Body	Av.
a	MSAT Cellophane	2/	-	28	22	25	31	32	31	44	32	38
b	Can	1st Operation roll	-	27	21	23	23	28	25	37	34	35
c	Can	Vacuum	-	13	8	10	12	9	10	17	14	15
d	Can	Vacuum	Water	12	7	9	14	10	12	13	10	11
e	Can	Vacuum	1% brine	10	7	8	12	11	11	16	10	13
f	Can	Vacuum	2% brine	9	7	8	10	7	8	11	8	9
g	Can	Vacuum	3% brine	8	7	7	10	6	8	12	7	9
h	Can	Vacuum	4% brine	8	6	7	9	6	7	11	9	10

1/ Fresh-picked crab meat will yield tenderometer values varying from 10 to 16, depending upon cooking time and other conditions. Freezing and thawing may lower these readings to values varying from 7 to 13.

2/ MSAT = Moisture-vapor-proof, sealable by heat, anchored coating, transparent.

*Salt = sodium chloride, NaCl chemically pure.

The tenderometer readings obtained are relative values. Values of 18 or more might be considered as indicative of a tough product from an organoleptic standpoint. Samples packed in moisture-vapor-resistant cellophane and in tin cans closed by the first operation roll only were too tough to be considered palatable after 3 months' storage. All of the remaining samples which were vacuum-packed in tin remained palatable over the entire period of storage. Body meat indicated a tendency to be more tender than leg meat. Toughness, as determined organoleptically, and the corresponding tenderometer readings increased gradually, from one 3-month examination period to the next, on the basis of readings averaged for leg and body meat.



Unfortunately, initial tenderometer readings were not obtained. However, if the original average tenderometer reading for this crab meat were taken as 10 (usual average for fresh frozen crab meat) then the increase in toughness over the first 3 months' storage period would be 150 percent and 130 percent for samples (a) and (b), respectively, and negligible amounts for the remaining samples. These results indicate that the greatest increase in the percent of toughening of crab meat sealed in moisture-vapor-resistant cellophane bags or friction-top tins occurs during the first 3 months of storage. The total amount of toughening that takes place in the samples not hermetically sealed is in the neighborhood of four or five times the total amount of toughening that takes place in samples hermetically sealed in a partial vacuum. Furthermore, the amount of toughening that does occur in samples not hermetically sealed renders them unpalatable.

Crab meat covered with water or brine of increasing concentration shows a slight tendency toward increased retention of tenderness; however, tenderometer readings become less accurate as they approach the lower end of the scale; so this trend is not clearly defined.

Color and Flavor: The color in the series of samples when examined organoleptically at 3, 6, and 9 months progressed in uniform steps from sample a to b, to c, etc., as follows:

a b c d e f g h →
Considerably faded, moderately faded, somewhat faded, normal color

Flavor in the series of samples when examined organoleptically at 3, 6, and 9 months progressed in uniform steps from sample a to b, to c, etc., as follows:

a b c d e f g h →
Unpalatable haylike flavor, lack of flavor, faint flavor, palatable flavor

Crab meat covered with water or brine shows a definite tendency toward increased retention of color and flavor with increasing concentrations of salt.

Note: These results should not be interpreted as a recommendation for the use of evacuated tin containers in the storage of frozen crab meat. Although such a packaging method would undoubtedly keep the product in an excellent condition over a long period of time, there is danger that if frozen crab meat were packed in ordinary tin cans, consumers or dealers might store the cans at room

temperatures regardless of any printed cautions. Under such conditions, frozen crab meat would defrost and spoil rapidly. When hermetically sealed, defrosted foods possess all of the requirements for the growth of Clostridium botulinum with consequent toxin production. The findings should serve to emphasize the fact that experimental means for retarding the toughening of frozen crab meat do exist.

LITERATURE CITED

SHOCKEY, CHARLES F.; McKEE, LYNNE G.; and HAMM, WILLIAM S.

1944. Instrument for measuring changes in texture of dehydrated fish. Ind. and Eng. Chem., Analytical Ed. 16, 638 pp.

FOOD FREEZING

Because of the need for constant low-temperature refrigeration up to the time of the product's use by the consumer, shortage of refrigerated facilities at any one point blocks expansion in the use of frozen foods. The existence of many millions of outmoded electrical refrigerators with inadequate frozen food storage space presents one of the most important equipment handicaps to expanding use of frozen foods in the home. Many postwar models now going into homes are also lacking in frozen storage space.

Of concern to the fishing industry are the problems growing out of seasonal variations in the production and marketing of fish. High rates of production create a supply in excess of requirements in most markets. Periods of overabundance are followed by scarcities with resultant affect on supply, demand, and price. Relief from these difficulties can come through the provision of adequate freezer and storage capacity in each producing center.

It is expected that there will be a period of adjustment during the early part of 1947 in the fish-freezing industry, when efforts will be made to adjust to peacetime demands. The duration of the shortage in cold-storage space will depend, largely, on the trend in freezing, and warehouses will be crowded until freezer capacity is expanded.

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