THE APPLICATION OF PLASTIC CONTAINERS FOR PACKING AND PASTEURIZING MEAT OF THE BLUE CRAB *(CALLINECTES SAPIDUS)*[1]

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Summary

Sixteen-ounce portions of regular grade crab meat were packed and pasteurized in hermetically sealed rigid polypropylene "Indeplas" 307 x 400 containers. Meat from the metal and plastic containers was evaluated periodically for six months. The plastic containers gave overall product protection equal to the metal cans. Some brittleness was experienced with the plastic containers when handled roughly at refrigerated temperatures. Appearance and flavor evaluation of experimental and control samples within each treatment resulted in no significant difference until approaching four months storage. At four months and thereafter, the meat from the plastic containers appeared whiter and imparted a sweeter, more natural flavor than the control samples packed in metal containers. A preference was observed for appearance and flavor of meat processed at 185 F over that processed at 190 F. Above 190 F the meat exhibited a greyish cast and a slightly cooked flavor. Texture evaluation data indicated no significant change throughout the storage testing. Bacteriological examination indicated that the contents in both containers should be processed 110 min at 185 F for adequate pasteurization. The metal containers, due to their increased diameter, exhibited a slightly slower come-up time.

Pasteurized crab meat is processed in metal containers. The can serves the crab meat packers as an economical container able to withstand pasteurization and handling practices. Pasteurization of crab meat in metal containers was first investigated by Anzulovic and Reedy *(1, 2)* and later by Fellers *(4)* who packed an improved product with an increased shelf life during the early 1940's. In 1951, Byrd *(3)* patented a pasteurization method for short-term refrigerated storage of crab meat in cans that is presently quite widely used by the industry. During the past few years, increasing interest has developed in the use of plastic containers for the packaging of semi-perishable foodstuffs by the food industries. To date, it has not been common practice to pasteurize in the container.

This study was designed to determine the feasibility of using a molded plastic hermetically sealed container as a substitute for the tinned containers. To accomplish a satisfactory substitution, the plastic containers should exhibit material rigidity and thermal properties able to withstand processing, refrigerated storage, and shipping stresses; product protection equal to metal containers; suitable design for utilizing standard can sealing equipment in the closing operation; plastic material composition that is approved by the Food and Drug Administration; and cost comparable to the metal containers.

After preliminary examinations, an experimental "Indeplas" 307 x 400 container[2] was selected for final testing.

Experimental Methods and Procedures

Beginning September 1, 1964, 300 lbs of regular crab meat was test-packed in 16-oz containers and processed at two commercial packing plants and the Seafood Processing Laboratory. Two-thirds of the meat was packed in rigid "Indeplas" 307 x 400 containers and the remaining third in regular 401 flat metal cans as controls.

Hermetic sealing of all plastic containers was accomplished with 307 sanitary style can ends on a small motor-driven Dixie Sealer utilizing only the first closing operation. Later, additional containers were also sealed on a regular Canco closing machine. Top seaming specifications established at this laboratory for the "Indeplas" containers and utilized throughout testing were (1st operation used only):

	Dixie Sealer	*Canco Sealer*
Seam Width	.095 ± .002	.100 ± .002
Seam Thickness	.111 ± .004	.116 ± .004

All metal containers were sealed in accordance with the can manufacturer's specifications.

Each of the three facilities processed 100 lbs of crab meat, using their own processing methods and procedures. At both cooperating plants and the laboratory, the processing equipment was essentially the same. However, there were variations in processing methods.

At plant number one, the harvested crabs were cooked and refrigerated two days before they were picked and the meat processed. Pasteurizing was carried out in a steam-heated water bath, large enough to accommodate two retort baskets, and maintained at a temperature of 185-187 F. Containers were racked in the baskets and processed 105 min. The initial internal temperature was 38 ± 2 F and during processing attained a maximum of 179 ± 2 F as determined by a Brown portable potentiometer. Following pasteurization, the retort baskets were immediately transferred to a tank containing ice-cooled water at 54 F. The baskets and contents were held in the cooling tank for 85 min, at which time internal container temperature reached 64 ± 2 F.

In plant number two, the crabs were cooked the day prior to picking and processing. Equipment for pasteurizing was similar to that of plant number one except that a pasteurizing temperature of 190-192 F for 115 min was used. The

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[2]Product of Independent Can Co., 900 S. Lakewood Avenue, Baltimore, Maryland.

initial temperature was 72 ± 2 F and reached 185 ± 2 F. Instead of the containers being racked directly into retort baskets, they were first put into covered bushel peach baskets before processing. The cooling cycle differed in that running tap water (61 F) was added to the cooling tank and discharged through an overflow pipe for 35 min, which brought the internal container temperature down to 128 ± 2 F. At this time, the containers in the bushel peach baskets were refrigerated until shipment to the laboratory for storage and testing.

The Seafood Processing Laboratory processed the third run using crabs cooked and refrigerated three days before being picked and processed. Processing was carried out in the same manner described for packer number one except that the processing time was 100 min at 185-187 F, with internal temperatures initially at 40 ± 2 F and reaching 180 ± 2 F. At the completion of the cooking cycle, the retort baskets were transferred to an iced cooling tank at a temperature of 37 F for 45 min. The internal temperature of the containers before transfer to mechanically refrigerated storage was 100 ± 2 F.

All samples were stored at the Seafood Processing Laboratory in a 33-35 F walk-in refrigerator for a period of six months. To ascertain the effect that light might have on the chemical decomposition of the crab meat fat components, one-half of the translucent plastic containers were wrapped in aluminum foil during storage; the other half were exposed to incandescent light as might be encountered in a retail market. When measured by a General Electric Foot Candle Meter Model 8DW20, the unwrapped containers were exposed to a 30-45 foot candle lumination for an average of two hours per day over the entire storage period.

Examination of samples in plastic and metal containers processed at 185 F for both 100 and 105 min exhibited bacterial growth exceeding Maryland Health Department standards. These standards specify a total absence of *Escherichia coli* and/or a bacterial count not to exceed 25,000/g. In the past, most commercial packers have pasteurized at 185 F for between 100 and 105 min, which was considered an adequate treatment for an extended shelf-life. However, recent examination of commercial samples has evidenced the existence of a bacillus type organism heretofore undetected. An inquiry among Atlantic Coast packers resulted in confirmation that they had experienced intermittent losses uncommon to the product over the past year. Therefore, tests were initiated at both plant number one and the Seafood Processing Laboratory to determine optimum corrective time-temperature relationships. After preliminary investigations, it was decided a new series of 25 containers, 15 plastic and 10 metal, should be processed at 185 F for 110 min at plant number one and evaluated.

Composite samples of the fresh crab meat were obtained in sterile bottles as the packing operations progressed. Bacteriological examinations of the fresh meat were conducted at both the Seafood Processing Laboratory and the Maryland State Department of Health Laboratory, using the latter's methods for Standard Plate Count, 25 C Plate Count, and *E. coli* most probable number per 100 g (*E. coli* MPN/100 g). Immediately following processing, and thereafter at six week intervals, the pasteurized meat was examined using the above mentioned testing methods.

In conjunction with bacteriological testing, sensory evaluations were conducted utilizing the nine point Hedonic Scale Rating System for determining statistical preference of appearance, texture, and flavor within each treatment (*5, 6*). Panels were also conducted to determine a preference between treatments as there were variations in heat-processing and cooling cycle times and temperatures. A panel consisting of 8-10 members of the laboratory staff participated in the testing program.

Shipping tests were conducted twice by common carrier from Crisfield to Baltimore, the wholesale distribution market for most of Maryland's seafood, and return during the refrigerated storage period. As commonly practiced by industry, the filled plastic containers were packed in the regular "C" fluted waxed cardboard shipping cartons, iced with flake ice, and secured with a metal band prior to shipment.

RESULTS AND CONCLUSIONS

Evaluation of the data compiled during this study indicated that the rigid plastic container can be utilized as an appropriate substitute in which to package and pasteurize crab meat. There are certain categories which show the plastic to be slightly superior to the metal and others in which the metal has the advantage. During storage, the plastic containers provided a better general appearance and retention of flavor in the product. However, the metal container offered more product protection in processing and in shipment due to its rigidity.

The "Indeplas" containers exhibited excellent thermal conduction and stress qualities (Figure 1) during the pasteurization and cooling cycles. No leakers were evident when the top seal closing specifications were followed. However, there was a tendency for the plastic to exhibit some brittleness at prolonged refrigerated temperatures. Care should be exercised to avoid excessive rough handling.

Bacteriological examination showed (Table 1) that crab meat, packed in both metal and plastic containers, and processed at a bath temperature of 185 F for 105 min or less, spoiled over a two to four month refrigerated storage period. This meat (Packer No. 1 and No. 3) exhibited 14% and 24% losses, respectively. In the first instance, product spoilage encompassed only the metal containers, while in the latter spoilage appeared in both the metal and plastic containers. No attempt was made to ascertain the spoilage organism beyond that it is a rod-shaped, catalase +, aerobic, gram-variable sporeformer typical of the genus *Bacillus*. Over the entire testing period *E. coli* MPN/100 g examinations indicated an absence of this organism in the samples. When temperatures of 185-187 F for 110 min and 190-192 F for 115 min were used, no spoilage was detected. However, the meat processed at the higher temperature exhibited a greyish appearance and off-flavor. It is recommended that crab meat, pasteurized in this container size, should be processed at a minimum time-temperature of 185 F for 110 min, which complies with the pasteurizing recommendation of the Maryland State Department of Health (*7*).

TABLE 1. COMPARISON OF PACKERS AVERAGE BACTERIAL TEST RESULTS

Code	Days storage	Packer 1 Time—105 min Temp.—185-187 F SPC/g	Packer 1 25 C/g	Packer 2 Time—115 min Temp.—190-192 F SPC/g	Packer 2 25 C/g	Packer 3 Time—100 min Temp.—185-187 F SPC/g	Packer 3 25 C/g	Final pack Time—110 min Temp.—185-187 F SPC/g	Final pack 25 C/g
CF[a]	0	$8.3x10^4$	$7.5x10^4$	$2.1x10^5$	$2.3x10^5$	$1.6x10^5$	$1.7x10^5$	—	—
PF[b]	1	<100	<100	<100	<100	<100	<100	<100	<100
P[c]	1	<100	<100	<100	<100	<100	<100	<100	<100
M[d]	1	$2.0x10^3$	$2.2x10^3$	<100	<100	<100	<100	<100	<100
PF	47	<100	<100	<100	<100	<100	<100	<100	<100
P	47	<100	<100	<100	<100	<100	<100	<100	<100
M	47	$1.2x10^7$	$1.4x10^7$	<100	<100	<100	<100	<100	<100
PF	103	<100	<100	<100	<100	<100	<100	<100	<100
P	103	<100	<100	<100	<100	<100	<100	<100	<100
M	103	$2.2x10^6$	$5.0x10^6$	<100	<100	<100	<100	<100	<100
PF	153	<100	<100	<100	<100	<100	<100	<100	<100
P	153	<100	<100	<100	<100	<100	<100	<100	<100
M	153	<100	<100	<100	<100	<100	<100	<100	<100
PF	205	<100	<100	<100	<100	$1.0x10^3$	$6.0x10^5$	<100	<100
P	205	<100	<100	<100	<100	$2.5x10^5$	$3.5x10^5$	<100	<100
M	205	$4.4x10^4$	$1.5x10^5$	<100	<100	$2.4x10^5$	$3.3x10^5$	<100	<100

[a]Composite Fresh.
[b]Indeplas 307x400 foil wrapped.
[c]Indeplas plain.
[d]Sanitary 401 Flat Cans.

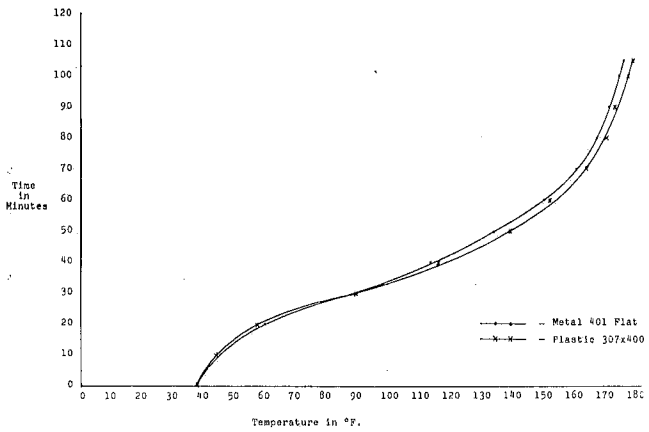

Figure 1. Typical Heat Penetration Plastic Vs. Metal.

Recommended initial temperatures should be within the 50-60 F range.

Sensory evaluation within each treatment over the six months period exhibited no significant difference between meat stored in metal and plastic until three and one-half months storage had elapsed. After this period, there appeared a significant difference (P-value = <.05) in appearance and flavor with the panel preference for meat stored in the plastic. The metal containers rendered a greyish tint to the meat along the side seam and imparted a slight metallic taste. Five and six month taste testing confirmed this observation, as the meat progressively acquired a more pronounced grayish cast and metallic off-flavor. Meat processed in plastic over the entire testing period maintained a more natural appearance and flavor. No significant difference in texture (P-value = >.05) was detected during storage.

When each of the 185 F treatments in plastic was compared with its counterpart at 190 F, there was a significant difference in both appearance and flavor (P-value = <.05). Again the meat processed at the lower temperature was preferred to that processed at 190 F. Panel comments indicated that the elevated processing temperature effected a greyish cast and slight cooked flavor in the meat, whereas the meat processed at 185 F possessed a more natural fresh crab meat appearance and flavor. No significant difference could be detected in the evaluations between the lower temperature treatments. Analysis of the texture data produced no difference between treatments.

Sensory and bacteriological testing over the storage period afforded no evidence of quality deviation because of the wide variation in each treatment's initial temperatures and those following the cooling cycles. Some of the differences which previously have been attributed to high processing temperature may be in part a result of these variations.

Foil wrapped plastic containers, as tested to determine the effects of light, showed no significant flavor difference when compared with the unwrapped containers. Presumably, the meat in the plastic containers should show no degradation when exposed to cold cabinet lights.

The filled plastic containers subjected to shipping tests, packed as described earlier, resulted in an absence of fractures. However, drop tests from as

low as three feet damaged the majority of these containers to the extent that they no longer afforded adequate product protection. Therefore, recognizing this factor of brittleness, the containers should be afforded the care exercised with glass containers such as milk bottles.

Since the termination of this project, further progress in the character of plastic composition has decidedly improved the undesirable brittleness. With this improvement, the plastic container is considered a more satisfactory substitute for the metal containers.

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