Immersion Freezing of Shrimp Aboard the Fishing Vessel

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For some time the firm of Mingledorff's Inc., has carried on, under the direction of Mr. W. H. Carpenter, a research program to develop a system suitable for holding shrimp on large shrimp trawlers. The approach has been parallel to that of the University of Miami in that we first developed a system for holding shrimp in refrigerated sea water. This system was satisfactory for a trip of 14 days or less but did not solve the problem for a large boat that made longer trips. We tried many things to prolong the 14 day period and met with some success, but basically raw shrimp after seven days, regardless of how they are handled, lose quality.

In the work with refrigerated sea water it was found that if the water was cooled below 32° the shrimp froze. By increasing the concentration of salt the temperature was lowered. The freezing was good but it was found that when the shrimp were held in storage the salt crystallized and the shrimp dehydrated. Glazing the shrimp did not help, since the salt made the glaze unsatisfactory, and furthermore, glazing aboard a vessel at sea would not be desirable.

We next experimented with a solution of sugar and salt with which the Fish and Wildlife Service had done some work. We found that it worked well for certain definite mixtures. Some salts were satisfactory and others were not; the same applied to various sugars. We finally perfected the solution to the extent that we could freeze shrimp at 0° to 5°F. in fifteen minutes or less, depending on the amount of agitation of the solution.

We next experimented with the holding qualities of these shrimp. It was found that shrimp frozen in this solution would not stick together, and remained separated during 60 days of storage in a large freezer room, when left in an open card-board master carton. Furthermore, there were no visual signs of dehydration. Shrimp when thawed out after 60 days in open storage looked as though they had just come from the water. A sample iced for seven days kept as well as fresh shrimp.

Repeated freezing of the same shrimp was attempted. Shrimp frozen as many as five times were still firm and had no tendency to separate from the shell.

From this knowledge we proceeded to apply the system to a conventional vessel. Mr. Henry Ambos of the Trade Winds Corporation allowed the first installation on his vessel, the *Miss Trade Winds.* From experience gained on the *Miss Trade Winds* we were able to simplify the installation of the next unit, which was installed on the *Prince Charming,* a vessel owned by John Fazio Shrimp Company and operated under the supervision of Tommy Fazio of Tampa, Florida.

The system as installed on the *Prince Charming* includes a freezing tank on deck. This tank, including insulation, is approximately 4'6" wide, 7'10" long and 4' high. It is of stainless steel on the inside and contains the freezing plates and solution. It is also equipped with a hydraulically driven propeller which circulates the solution through the plates and then through the shrimp. The refrigeration is supplied by a diesel-driven unit which can be located

anywhere space is available. The latter is approximately 6'4" long, 2' wide and 4'10" high. The cargo hold is converted to a frozen storage room by use of plates and another diesel driven unit slightly smaller than the freezing unit.

The procedure used on the boat is as follows: After a drag is completed the shrimp are headed and thoroughly washed. The shrimp may then be weighed in 50 pound lots and dumped into special stainless steel wire baskets which are designed with a patented closing feature. The basket is then placed in the tank in guides that hold it in place. The shrimp immediately freeze, and if the basket is raised the shrimp fall apart and completely fill the basket. This gives space for the solution to pass readily through the shrimp. After 15 minutes the shrimp are completely frozen. Whenever it is convenient the baskets are picked up and tipped to drain. It is important to get the shrimp into the holding room as soon as possible after freezing. The shrimp are now dumped into baskets and placed in the storage room. On the *Prince Charming* the entire cargo hold had been converted to 0°F storage space, overhead plates supplying the refrigeration. At the end of the day, or at the crews' convenience, the shrimp in the baskets are dumped into 50 pound master cartons. A wooden grating installed on the floor and sides of the holding room allow circulation of the cold air completely around the cartons. The cartons are stacked as closely together as possible, starting at the outside and working to the center. Once the shrimp are placed in the cartons there is no further necessity to handle them until they are unloaded.

It is useful to compare this with the more conventional systems on freezer boats. These systems vary a great deal but the basic procedure is similar. Since the process of freezing is much longer it is not practical to freeze during the dragging, so the shrimp are held in a tank on deck until the end of the fishing. The shrimp are removed from the tank as they are processed. First, five pound cartons are assembled and the shrimp are placed in them and weighed. Next, the five pound cartons of shrimp are placed on the freezer plates. Since the shrimp are in a box and the only contact with the plate is from the bottom the shrimp slowly freeze from the bottom up. The lower shrimp freezing first tend to insulate the carton, and the top shrimp freeze very slowly, the freezing time varying from 8 to 14 hours. These shrimp cannot be held any length of time without glazing, therefore, on the better boats extra fresh water is carried and each carton is opened, water poured in, and the cartons are again placed on the plates and refrozen. The five pound cartons are now removed from the plates and packed in 50 pound master cartons. In the immersion freezer system practically no time is spent by the crew in the refrigerated space. On the other system hours must be spent actually in the freezer space, which of a necessity must be at a lower temperature than a storage room.

A large consumer of frozen shrimp is the breader or other processor. A processor receiving frozen shrimp in five pound cartons has to tear off the carton and put the shrimp in a tank of water, usually overnight, to thaw them. The outside shrimp thaw during the night while the inside are still in a block of ice. Immersion frozen shrimp thaw faster, because when the 50 pound carton is dumped the shrimp immediately separate and in 30 minutes are completely thawed. In retail markets immersion-frozen shrimp are kept in the freezer in 50 pound cartons. If the operator needs 25 pounds

he can take them from the carton, wash them and put them on the counter as raw shrimp. They are far superior in appearance and quality to shrimp brought which have been stored in ice.

Or consider the large hotel or restaurant chefs. If they have shrimp in five pound cartons, they have to anticipate their consumption accurately, because of the length of time necessary to thaw the shrimp. With individually frozen shrimp they can take out a small number and it is easy to get more during the day. Another advantage is that the shrimp can be repackaged as frozen shrimp in the merchandisers own package, without thawing them.

Quality is of the first importance in frozen food and shrimp frozen as soon as possible after they are caught are the best quality. Experts have told us that they can identify frozen shrimp from fresh shrimp, but we have seen them fail with shrimp frozen by our system. For example, immersion-frozen shrimp are not dessicated in the tail region as are many frozen shrimp. Pink shrimp, when they are first caught, have a bright pink spot on the side. During ice storage this disappears. On immersion-frozen shrimp the pink spot returns after the shrimp are thawed.

Finally, is the important fact that the refrigeration can be operated above a vacuum, because of the higher freezing temperatures, eliminating a lot of difficulties normally experienced. With two separate systems, should something happen to the holding room unit, the freezing unit can be operated to hold the storage room. We have avoided the use of electrical controls or electrical motors.

On the first trip of the *Prince Charming* Mr. Fazio brought several of his other boats fishing in the area to the *Prince Charming* and using extra help of the vessel being unloaded processed 3380 pounds of shrimp in 11 hours. This kind of volume is impossible on the conventional freezer boat.

It is our feeling that the immersion type of freezing using the solution giving the protective coating is the answer that the shrimp industry has been looking forward to. We have a quality product, rugged equipment at a comparatively low cost.

La Aplicación Práctica de Congelamiento por Medio de Immersión a Bordo de un Bote de Red de Arrastre

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Abstracto

Este manuscrito describe un congelador de tipo de bodega de immersión para congelar camarones en alta mar.

El sistema consiste de un tanque sobre cubierta que contiene una solución congelante de sal y azúcar. Un motor diesel, de refrigeración, distribuye el refrigerante a través del tanque refrigerador; la bodega que está aislada, es mantenida a 0°F por medio de una unidad de refrigeración separada.

50 libras de camarones descabezados son colocados en cestas de alambre especial de acero inoxidable. Después de 15 minutos de immersión en la

solución congelante, los camarones quedan sólidamente congelados, siendo después almacenados en cartones de 50 libras, en la bodega refrigerada. Experiencia práctica con este equipo a bordo de botes pesqueras comerciales, demuestra un ahorro en fuerza manual, así como mejor calidad y más facilidad en el manejo del producto congelado.

Fish Oils and Proteins: Their Contributions to the World's Feed Supply

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In the United States the total supplies of high protein feeds for 1953-54 and 1954-55 are estimated at a little more than 13 million tons. Of these totals, fish meal represents slightly more than 2.6 percent, but if expressed in terms of oilseed equivalent the figure would be 3.6 percent. Admittedly, these appear to be insignificant parts of the whole, but without this ingredient, with its multiple values, it is highly probable that we would not have been able to achieve the extraordinary improvements in feed conversions, especially in broiler and turkey starters, which we have witnessed since 1946. For instance, in these eight short years there has been a 28 percent improvement in feed conversion so it is now possible to raise broilers at a rate of one pound of meat for each 2½ pounds of feed. Similar, though less spectacular, gains are seen in other livestock growth trends. This is one major reason why apparent civilian consumption of eggs is up 39 per cent, chickens 85 per cent, and turkeys 114 per cent in 1954 by comparison with 1935-39 averages.

Fish meal of good quality provides more of the essential amino acids, which are most likely to be of dubious availability or short of requirements when vegetable sources are relied upon, than any other protein ingredient. Three of these—lysine, methionine, and tryptophane—show to particular advantage in fish meal. In fact, fish meal normally contains twice as much, or more, of the first two and fifty per cent, or more, of tryptophane than any of the commonly-used vegetable protein products which make up nearly 80 per cent of all high-protein supplies.

In addition to its peculiar amino acid qualities and highly available protein there are present in fish meal abundant supplies of B-complex vitamins, especially vitamin B_{12}, phosphorus and trace elements, the unknown "fish factor(s)", in some cases vitamin A and D, and energy in the form of fat. Much has been said and written of their value over the years and it is now acknowledged that these fish products are difficult to replace in our modern complex feeding program. Few products have ever been studied as intensively as fish meal and fish solubles have been in the past five years. If it were not for the recognized factors, known and unknown, which these products contribute to feeds, efforts would not have been expended to isolate and produce them synthetically, by fermentation, or otherwise. Undoubtedly the time is not distant when the unknowns will become knowns, but the fish products