

Care and Maintenance of Squid Quality

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INTRODUCTION

The squid resources of the Atlantic may eventually represent a substantial fishery for U.S. fishermen (Rathjen, 1973; Ampola, 1974; Lux et al., 1974). One current problem associated with this fishery is a general lack of knowledge in the proper handling of squid at sea and through the processing and distribution stages. Typically, squid is handled as an incidental catch by fish trawlers and treated the same as finfish. The trap fishery for squid is primarily a small-boat fishery, and the catch is sometimes not iced at sea. In southern New England, it has been common practice to pack squid in barrels with either ice or ice and seawater.

If not handled properly, squid undergoes rapid spoilage, usually beginning with a discoloration of the flesh (yellowing) followed by a sour odor. In advanced stages of spoilage, ammonia is readily detectable. Another problem area is mechanical damage. Bulk icing, shoveling of the catch, and dense packing of squid all lead to crushing of the squid, broken ink sacs, and broken and torn skin, detracting from the appearance as well as the overall organoleptic quality.

EXPERIMENTAL RESULTS

Icing

Tests were carried out at this Laboratory on the iced shelf life of squid. From May to September, commercially caught samples of both *Illex illecebrosus* (summer squid) and *Loligo pealei* (bone squid) were transported to the Laboratory and iced in boxes with

different squid-to-ice ratios—1:1, 2:1, and 5:1. Each day, samples were examined by a raw-evaluation panel in the Laboratory for spoilage. The following table shows the number of days to the onset of spoilage after catch as determined by odor and appearance by a Laboratory panel.

Sample	Squid-to-Ice Ratio		
	1:1	2:1	5:1
<i>Illex</i> (Gloucester day boat)	5	5	4
<i>Illex</i> (Pt. Judith Trawler)	8	8	7
<i>Loligo</i> (Pt. Judith Trawler)	6	6	3
Average	6.3	6.3	4.7

In general, these tests indicate that squid spoils more rapidly than finfish and must be handled very quickly and kept well iced at all times.

Another series of tests were carried out on the iced shelf life of *Loligo* caught in the winter months by the *Valkyrie* out of New Bedford, Mass. The squid were iced immediately after catch at about a 2:1 squid-to-ice ratio. Samples were set aside in boxes from each day's catch and, upon landing, were transported to the Laboratory for evaluation. In all, 17 determinations were made from three trips with the onset of spoilage averaging 9 days after capture.

It should be noted, however, that the laboratory samples used in these tests were boxed at sea after capture, and the indication was that the bulk-held squid iced in pens for commercial use were damaged physically in comparison with the boxed squid.

One potential method of holding squid is chilled seawater (CSW) (Karsti and Blokhuis, 1966; Hulme and Baker, 1977). Recent research on the use of CSW systems for holding mixed species and herring in bulk quantities aboard vessels showed that the softer fleshed species such as whiting and herring maintain excellent quality and undergo relatively less mechanical damage using a mixture of three parts fish to one part seawater and one part crushed ice in an insulated hold or tank (Baker and Hulme, 1977). Chilled seawater systems aboard vessels have the potential of cooling squid rapidly and holding them at low temperatures with a minimum of physical damage.

A series of tests were carried out cooperatively with a commercial trawler, the *Jeanne D'Arc*, and Ocean Crest Seafoods in Gloucester, Mass., to determine the feasibility of CSW holding of squid at sea. Four tests were completed in which squid held in CSW were compared to samples boxed at sea using a 2:1 squid-to-ice ratio and to penned squid handled in the normal commercial manner (approximately a 3:1 squid-to-ice ratio). An insulated plastic tank capable of holding about 300 pounds of squid was used for these tests using a 3:1:1 squid-to-ice-to-seawater ratio.

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Prior to beginning the fishing operation, the tank was charged with 100 pounds of ice and 100 pounds of seawater. On the first day of fishing, 300 pounds of squid were stored in the CSW tank, and a duplicate sample was boxed according to the experimental outline. Upon landing, the CSW tank and the boxed samples were brought to the Laboratory for testing along with a corresponding sample of the penned squid which were all caught during the last 2 days of fishing. All the samples were re-iced, if necessary, and held until they were considered to be of poor quality by our raw-evaluation panel.

The following table shows the results of these trials indicating the total number of days after capture until the squid were considered to be of unmarketable quality by the Laboratory panel.

Holding method	Trial				Avg.
	1	2	3	4	
CSW	14	8	7	7	7.3
Boxed at sea	6	7	5	6	6.0
Penned at sea	5	5	—	—	5.0

In general, these results indicate that the CSW method of holding resulted in an extension of shelf life over the other two methods. Not only did the squid maintain a higher overall quality, but also the physical condition was better. After 3 or 4 days at sea, the CSW-treated squid were remarkably different in outward appearance. The color of the skin was whiter, most of the squid were still in rigor, and instances of crushing

¹Not enough ice was used in this test, and the temperature of the CSW reached 46°F (8°C); therefore, this result was eliminated from the average calculation.

and broken skin were virtually eliminated. These results definitely show that CSW holding of squid is worth investigating for large-scale bulk holding.

Freezing

Studies on the acceptability of frozen squid indicate, in general, that both species of squid have excellent freezing characteristics provided 1) the initial quality is high and 2) they are frozen rapidly. Results of frozen storage tests carried out at the Laboratory show that both whole squid and cleaned squid (*Illex*) were still rated good by taste panels after 13 months of frozen storage at 0°F (-18°C). Another series of tests on *Loligo* showed similar results. Additional tests indicated that thawing and refreezing does not substantially reduce overall quality. Whole squid frozen for periods up to 1 year can be thawed, cleaned, processed into breaded strips, and refrozen with an expected frozen shelf life of 6-12 months. Of course, the time spent in thawing, processing, and refreezing should be kept to a minimum to prevent quality losses.

RECOMMENDATIONS

Some general recommendations can be made for the maintenance of squid quality

Icing

- 1) The catch should be iced immediately after capture.
- 2) Squid should be shelved or boxed to reduce physical damage.
- 3) Squid-to-ice ratios should not exceed 3:1. A 2:1 ratio is recommended, if possible, with the squid and ice well intermixed.

4) CSW systems should be investigated on a commercial scale using a 3:1:1 squid-to-ice-to-water ratio.

5) All sorting and processing should be carried out rapidly taking care to maintain as low a temperature as possible.

Freezing

1) Only good-quality squid should be frozen.

2) The containers and cartons should be relatively thin to promote rapid freezing.

3) Plate freezing or blast freezing is recommended with adequate spacing to promote efficient heat removal.

4) Storage temperatures of 0°F (-18°C) or below are necessary.

5) All thawing, processing, and refreezing operations should be carried out as rapidly as possible to prevent quality losses.

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