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Temperature affects quality, safety of quahog clams

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Dead clams present a safety risk to consumers

Study results indicated care should be taken to ensure quahog clams are not exposed to temperatures exceeding 7 degrees-C during distribution and marketing.Contaminated seafood is responsible for much of the worldwide foodborne illness. In the United States, seafood accounts for 26.5 percent of all reported disease outbreaks. The majority of these illnesses are associated with the consumption of raw molluscan shellfish.

The common waterborne bacterium *Vibrio parahaemolyticus* is naturally present in estuarine, marine and coastal environments throughout the world. This microorganism is frequently isolated from a variety of raw seafood, particularly molluscan shellfish. The microorganism is a common cause of foodborne illness in American, Asian and European countries.

Temperature control of clams

Many countries have established regulations on the cooling rates of clams when the temperatures of the waters in which the clams are grown rise during the summer season. Also, many seafood dealers have enacted policies on the temperatures to which clams can be exposed from harvesting through final consumption to minimize microbial pathogen growth.

Many clam growers and their distributors market their products within hours after harvest. In order to rapidly cool clams to the temperatures required by regulators and dealers, significant mortalities may be experienced through thermal shock.

Adult Asiatic clams have been reported to suffer 50 percent mortalities when exposed to a post-harvest temperature of 2 degrees-C for 30 minutes. Dead clams must be discarded by the shell stock shipper or the receiving agent, resulting in significant financial losses. Also, dead clams can present a safety risk to consumers through the growth of pathogenic microorganisms.

However, it is sometimes difficult to distinguish between dead and live stock if the shells of the dead clams remain closed. In order to ensure product safety and minimize economic losses, a staged temperature reduction that maintains stock viability while preventing the proliferation of *V. parahaemolyticus* can be employed.

Tempering methods

Three tempering methods were studied to determine the effects of varied temperatures on populations of *Vibrio* species and clam survival.

Treatment 1

In this, the process recommended by the Interstate Shellfish Sanitation Conference for oysters in the United States, harvested clams were held for five hours at 32 degrees-C, then moved to storage at 7 degrees-C.

Treatment 2

Harvested clams were held for five hours at 32 degrees-C, followed by 12 hours at 8 degrees and 12 hours at 13 degrees before long-term storage at 7 degrees-C.

Treatment 3

Harvested clams were held for five hours at 32 degrees-C, followed by 24 hours at 18 degrees before long-term storage at 7 degrees-C. The study was replicated three times when the temperatures of the growing water exceeded 29 degrees-C during the day. Temperatures were continuously monitored using waterproof miniature data loggers.

Treatments 2 and 3 were examples of how a tempering process can maintain product safety while minimizing product loss. However, many other tempering methods could provide similar or perhaps even more effective results. Individuals involved in the harvesting and marketing of clams are encouraged to identify what temperature reduction methods best complement their business operations.

Plate counts, fecal coliforms

The information in Table 1 indicates significant differences in plate counts for the treatments. Although the counts for treatments 2 and 3 were not significantly different from one another on days 1, 7 and 21, they were significantly lower than those for treatment 2. Plate counts on day 14 for treatment 2 were significantly lower than the counts for treatments 1 and 3.

Flick, Total aerobic plate counts, Table 1

	Day 0 (Ambient Temp.)	Day 1	Day 7	Day 14	Day 21
Treatment 1	2.3×10^4	$2.2 \times 10^{6\ a*}$	$4.4 \times 10^{6\ a}$	$4.1 \times 10^{6\ a}$	$2.7 \times 10^{6\ a}$
Treatment 2	2.3×10^4	$5.6 \times 10^{5\ b}$	$1.1 \times 10^{6\ b}$	$9.0 \times 10^{5\ b}$	$1.6 \times 10^{5\ b}$
Treatment 3	2.3×10^4	$8.9 \times 10^{5\ b}$	$1.3 \times 10^{6\ b}$	$1.3 \times 10^{6\ a}$	$4.8 \times 10^{5\ b}$

Values with different letters within columns are statistically different (P < 0.05).

Table 1. Total aerobic plate counts (CFU/g) of clams for tested storage treatments.

The fecal coliform counts were less than 230 MPN/100 grams of clam meat for all storage days and tempering methods. MPN is a multistep comparative test that yields a “most probable number” of bacteria in water or tissue samples.

Effects on *vibrio* populations

Vibrio species have been found in 52 percent of mussel and clam species in Spain, with *V. alginolyticus* the most common, followed by *V. parahaemolyticus*. Similar results have been reported in France and Turkey. However, not all *V. parahaemo lyticus* isolates in these studies tested positive for the *tdh* and *tdr* genes, which have been related to pathogenesis.

In this study, the total *Vibrio* population included *V. parahaemolyticus, V. alginolyticus, V. fluvialis* and *Aeromonas hydrophila* (Table 2). The results showed that total *Vibrio* counts did not change significantly on days 1 and 14. However, counts in treatments 2 and 3 were lower than in treatment 1 on day 7.

Flick, Total Vibrio counts, Table 2

	Day 0 (Ambient Temp.)	Day 1	Day 7	Day 14
Treatment 1	1.4×10^4	$2.7 \times 10^{5\ a*}$	$2.8 \times 10^{5\ a}$	$7.4 \times 10^{4\ a}$
Treatment 2	1.4×10^4	$3.6 \times 10^{4\ a}$	$9.1 \times 10^{4\ b}$	$7.2 \times 10^{4\ a}$
Treatment 3	1.4×10^4	$2.3 \times 10^{5\ a}$	$5.3 \times 10^{4\ b}$	$6.2 \times 10^{4\ a}$

Values with different letters within columns are statistically different (P < 0.05).

Table 2. Total Vibrio counts (MPN/g) of clams for tested storage treatments.

When the clams were harvested, the levels of *V. parahaemolyticus* were low, as expected (Table 3). On days 1 and 7, treatment 1 had significantly higher populations than those for treatments 2 and 3, which were similar to each other. On day 14, the levels of *V. parahaemolyticus* were highest for treatment 3.

Flick, Total Vibrio parahaemolyticus counts, Table 3

	Day 0 (Ambient Temp.)	Day 1	Day 7	Day 14
Treatment 1	Above 3×10^3	$1.0 \times 10^{5\ a*}$	$4.3 \times 10^{4\ a}$	$3.0 \times 10^{3\ b}$
Treatment 2	Above 3×10^3	$1.2 \times 10^{4\ b}$	$1.9 \times 10^{4\ b}$	$1.2 \times 10^{4\ b}$
Treatment 3	Above 3×10^3	$8.6 \times 10^{2\ b}$	$2.2 \times 10^{4\ b}$	$2.7 \times 10^{4\ a}$

Values with different letters within columns are statistically different (P < 0.05).

Table 3. Total Vibrio parahaemolyticus counts (MPN/g) of live clams for tested storage treatments.

It is noteworthy that the increases in *V. parahaemolyticus* populations for all treatments and storage days increased by approximately 1 log10. Therefore, the levels of the microorganism in the clams should not present a health hazard to healthy individuals. However, care should be taken to ensure the clams would not be exposed to temperatures exceeding 7 degrees-C during distribution and marketing.

Perspectives

The percentages of surviving quahog clams at the end of the 21-day storage period were 87 percent for treatment 1, 83 percent for treatment 2 and 66 percent for treatment 3. The results of the study showed that a tempering process can produce high survival rates without compromising safety.

The treatments described in this study may not produce similar results for quahog clams grown in other areas or even different clam species. However, the study clearly demonstrated that high mortalities resulting from cold shock can be prevented when clam temperatures are gradually reduced.

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