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Intelligence

High-OTR packaging helps protect seafood consumers from botulism

1 July 2006

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C. botulinum can survive heat treatments through its ability to produce spores

USFDA guidelines recommend oxygen-transmission rates for vacuum packaging delivered by 1.5-mil polyethylene film. The clear film resists leaking and shows product well.

Clostridium botulinum toxin formation on seafood can result in illness and death if a contaminated product is consumed. The toxin is one of the most poisonous naturally occurring substances known. It can be destroyed by heat (boiling for 10 minutes), but processors cannot rely on this as a means of control.

C. botulinum strains are divided into two groups: the proteolytic group, those that break down proteins; and the nonproteolytic group, those that do not break down proteins. All strains of *C. botulinum* grow best in conditions where little or no oxygen is present.

Certain psychrotropic strains of nonproteolytic *C. botulinum* primarily associated with fish can grow and produce toxin at temperatures as low as 3.3 degrees-C. Proteolytic strains can grow and produce toxin at temperatures slightly above 10 degrees-C, but these are more easily detected, since they also produce unacceptable odors in foods.

The greatest hazard of *C. botulinum* contamination in food comes from the nonproteolytic, psychrotropic strains because they do not cause odors that result in rejection of the food.

Heat treatment

Vegetative cells of all types are easily killed by heat. *C. botulinum* can survive heat treatments through its ability to produce spores that are very resistant to heat. The spores of the proteolytic group are much more resistant to heat than those of the nonproteolytic group. However, there are indications that some substances naturally present in some foods, such as the enzyme lysozyme, may enable nonproteolytic *C. botulinum* to more easily recover after heat damage, resulting in the need for considerably more aggressive processes to ensure its destruction.

Reduced-oxygen packaging

Packaging methods that reduce the amount of oxygen present in the package extend shelf life by inhibiting the growth of aerobic spoilage bacteria. The benefits of this anaerobic environment also come with increased potential for the formation of *C. botulinum* toxin before the product appears or smells spoiled.

Reduced-oxygen packaging methods include vacuum packaging and modified or controlled-atmosphere packaging, which directly reduce the amount of oxygen in packages. Packaging in hermetically sealed containers such as double-seamed cans, glass jars with sealed lids, and heat-sealed plastic containers; deep containers from which the air is expressed; or packaging in oil prevent the entry of oxygen into the containers. Any oxygen present at the time of packaging is rapidly depleted by the activity of spoilage bacteria, resulting in a reduced-oxygen environment inside the packaging vessel.

Temperature abuse

While processors usually provide proper temperature control of seafood products, temperature abuse is not uncommon throughout the distribution and retail chain. Additionally, some commercial equipment is incapable of maintaining foods below 7.2 degrees-C because of refrigeration capacity, insufficient refrigerating medium, or poor maintenance. Surveys of retail display cases indicate that temperatures of 7 to 10 degrees-C are not uncommon. Surveys of home refrigerators indicate that temperatures can exceed 10 degrees-C.

High-OTR packaging materials prevent surface dehydration and freezer burn because of their tight fit. Photo by Bob Lane, Virginia Tech.

New packaging materials

Traditional control measures to prevent *C. botulinum* toxin production have included freezing, normal refrigeration temperatures of 4.4 degrees-C, and the use of time/temperature recorders or indicators. However, new packaging materials offer another method of providing protection from botulism poisoning.

In late 2002, the United States Food and Drug Administration issued permeability-rate guidelines for vacuum-packaged fresh fish that recommended an oxygen-transmission rate (OTR) at a specific temperature and relative humidity of at least 10,000 cc per square meter per 24 hours, which is delivered by, for example, 1.5-mil polyethylene film. This can be compared to an oxygen-impermeable packaging such as 2.0-mil polyester, which can have an OTR lower than 100 cc per square meter per 24 hours.

High-OTR packaging materials also prevent surface dehydration and freezer burn because of their exceptionally tight fit. The packages are leak-resistant, helping to minimize the risk of cross-contamination. The packaging film also has superior clarity and provides an unobstructed view of the product.

(Editor's Note: This article was originally published in the July/August 2006 print edition of the Global Aquaculture Advocate.*)*

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