

The Efficacy of Peroxyacetic Acid (PAA) Against Micro-organisms  
Present in a Seafood Processing Brine

Background

A New England processor of fresh scallops soaks the shelled seafood in a chilled trisodium phosphate (TSP)-fortified sodium chloride brine prior to packaging. The scallops can be immersed in the solution for up to four days. Recognizing that a treatment of the brine with an antimicrobial chemistry could represent an important HACCP intervention step and increased shelf-life, the processor was considering dosing the brine with peroxyacetic acid (PAA). The FDA has approved Enviro Tech Chemical Services' Perasan MP-2 at a level up to 190 ppm as PAA for use in seafood processing applications (FCN 699).

This report describes a series of laboratory tests that were undertaken in order to assess whether Perasan MP-2 addition to the brine represents an economical and efficacious means of controlling spoilage and pathogenic micro-organisms that are introduced into the brine and that proliferate during the soaking process.

Methods

A sample of brine that had been used to soak scallops was received from a New England processor of fresh seafood. It had a strong fishy odor. One pound of large thawed scallops was purchased from a local supermarket and introduced to the processing brine so that the level of scallops accounted for about 80% of the total volume. The brine and scallops were then chilled on an ice bath to bring the temperature down to around 40°C. Then the brine was sampled and serially diluted for plating onto 3M Petrifilms for aerobic bacteria and yeast and molds. The aerobic bacteria was incubated at 35° C for 48 hrs, and the yeast-mold Petrifilm plates were incubated at 25° C for 96 hrs.

Perasan MP-2 was dosed to the brine to a nominal level of 100 ppm as PAA and the level was tracked for the next 5 hours using the modified DPD colorimetric method. After an arbitrary one hour contact time, the brine was resampled for further microbiological analysis. For the next two days the scallops and brine were kept at around 40°C using an ice bath or a refrigerator. Then the brine was resampled for final microbiological analysis to determine whether microbe population had rebounded since the initial dose was administered (two days earlier).

Results and Discussion

Figure 1 charts the decomposition of PAA (from Perasan MP-2) charged to the scallops-containing brine. Initially, with a charge of 100 ppm, only 70 ppm of PAA was recovered, representing an immediate 30 ppm PAA demand. Therefore the brine was redosed with another 50 ppm PAA to achieve the initial 120 ppm level. Over the next

several hours, the PAA undergoes a steady decomposition and was essentially depleted after 5 hours when the level was only 3 ppm.

Figure 1

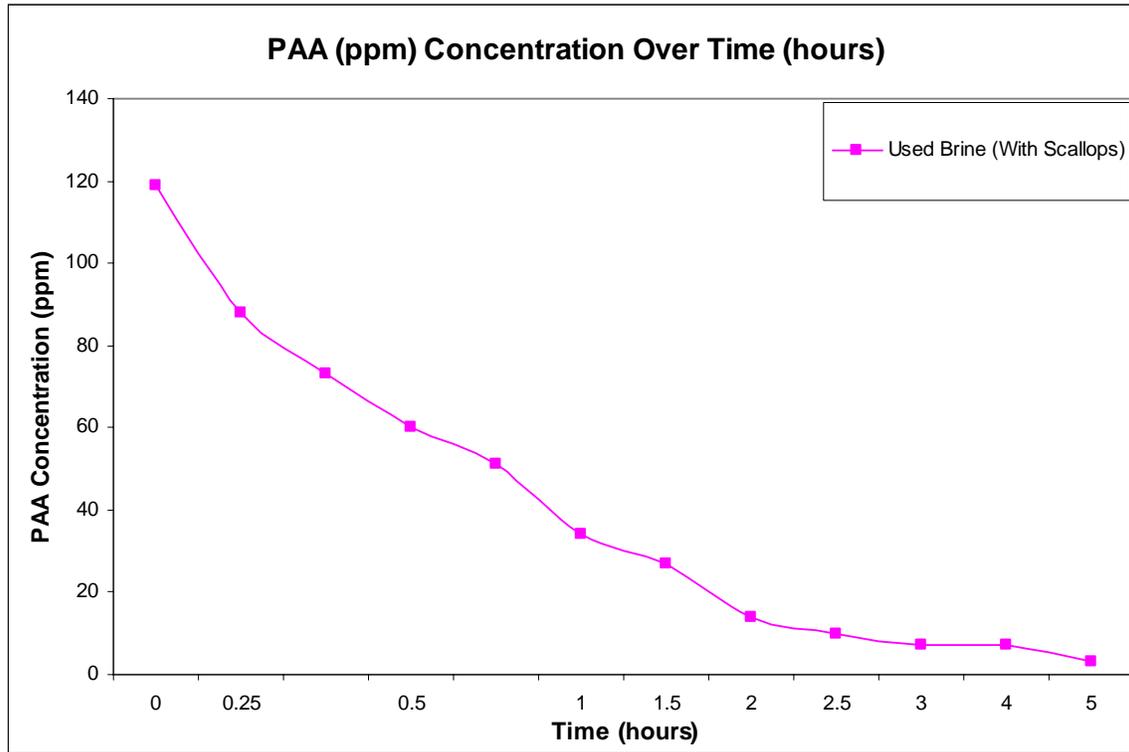


Figure 2 shows that the untreated (control) brine was highly contaminated with microbiological matter at  $\log_{10}$  6.56 CFU/ml aerobic bacteria and  $\log_{10}$  2.83 CFU/ml of yeast and molds respectively. However, following a one-hour contact with initially 120 ppm of PAA from Perasan MP-2, the numbers were reduced to just 0.7 CFU/ml for both micro-organisms. Figure 2 also indicates that there was some rebound in the microbe population after two days from the initial PAA dose, even though the brine was maintained in a chilled condition. Aerobic bacteria counts had climbed to  $\log_{10}$  2.52 CFU/ml and yeast and mold counts were up to  $\log_{10}$  1.15 CFU/ml. This rebound would suggest that Perasan MP-2 should be recharged to the brine to compensate for the amount that is depleted, and perhaps two or maybe three doses over the maximum 4-day soak time would be necessary for optimum microbiological control.

Figure 2

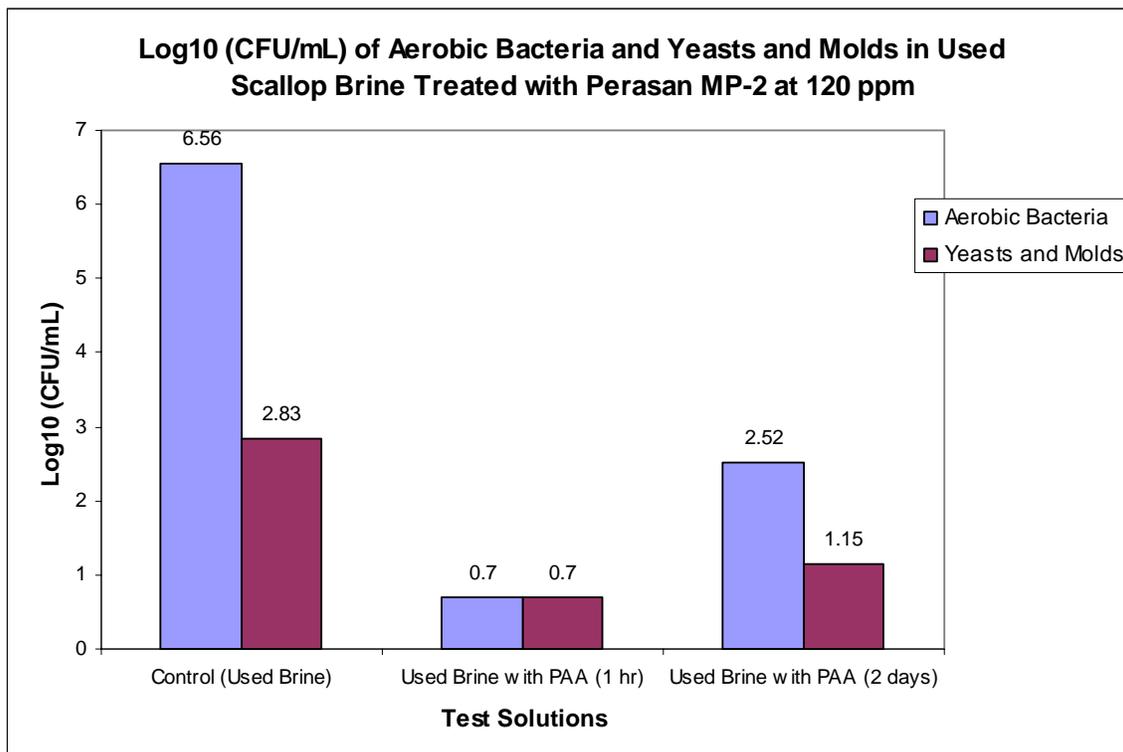
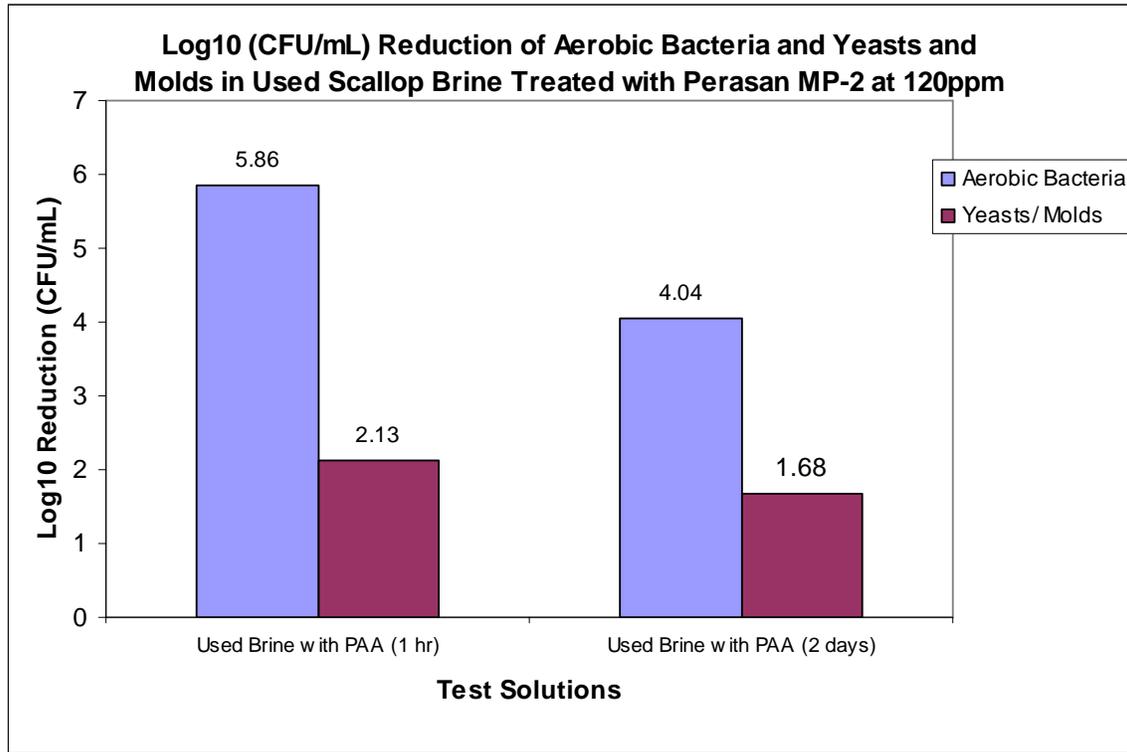


Figure 3 charts the log<sub>10</sub> CFU/ml *reduction* for both sets of micro-organisms that an initial 120 ppm dose of Perasan MP-2 to the scallop brine achieved after 1 hour and two days. To put these numbers into perspective, a log<sub>10</sub> 5.86 reduction in aerobic bacteria after one hour represents a 99.99986% depletion, and log<sub>10</sub> 2.13 reduction in yeast and molds is equivalent to a 99.280% decline.

Figure 3



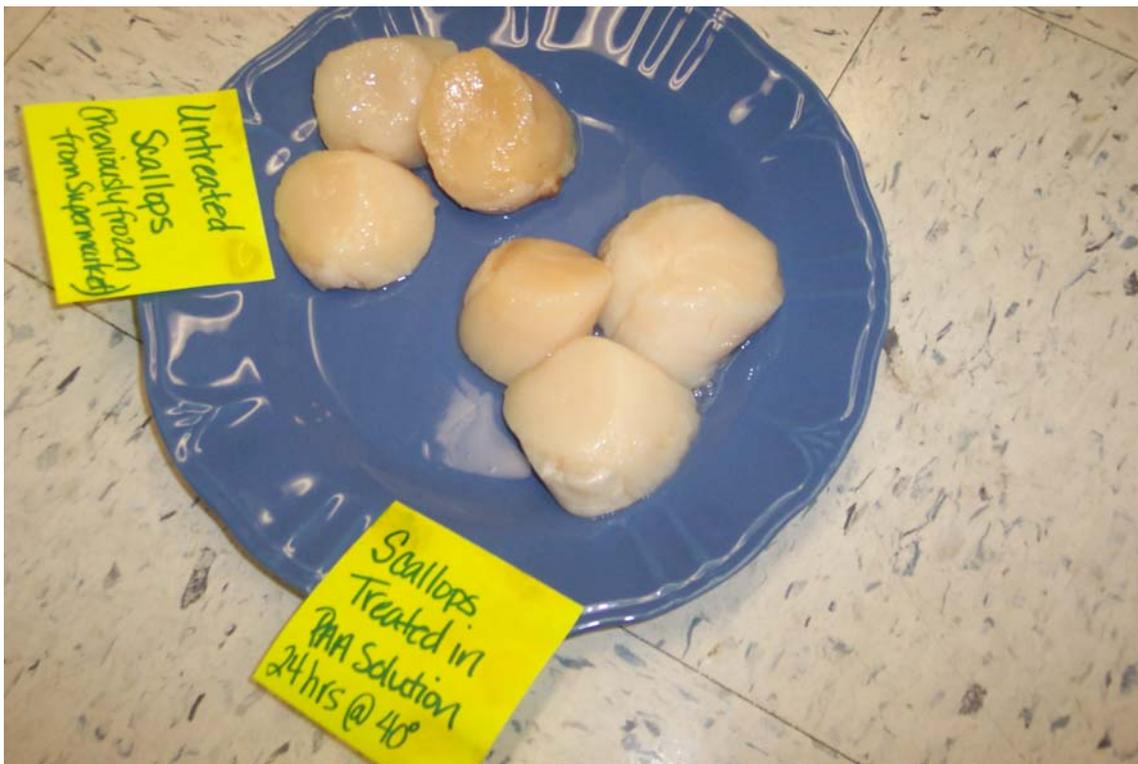
Aerobic bacteria along with yeast and molds can accelerate the spoilage of seafood as well as posing a pathogenic threat if the food is not properly handled and cooked. Treating the scallop processing brine with Perasan MP-2 represents a useful chemical intervention measure to improve any HACCP program that the processing plant currently practices.

Fresh seafood is prone to rapid deterioration by enzymes produced by flesh and intestinal aerobic bacteria. *Pseudomonas* species that thrive at low temperatures are particularly problematic and cause proteolysis of the fish flesh into volatile amines that give rotting fish its distinctive malodor. Thus, eradication of these organisms by adding Perasan MP-2 to the brine soak tanks would enhance and extend the quality, freshness and odor of the product. Extended shelf-life would be an obvious result, which has a favorable economic consequence for the processor or distributor.

Practical Effects of Perasan MP-2  
on the Appearance, Texture and Taste of the Scallops

Shortly after introducing Perasan MP-2 to the scallops-containing brine, it was noticed that the scallops appeared to increase in whiteness. This was not entirely surprising because PAA is an excellent bleaching material and is actually the active ingredient present when non-chlorine bleaches are employed in laundry applications. After 24 hours soaking in brine, the Perasan MP-2-treated scallops were photographed alongside those that had received no treatment. There were no differences noted for any other physical characteristics, such as odor or texture. The resultant picture is shown in Figure 4 below.

Figure 4 Comparison of Perasan MP-2 treated, and Untreated Scallops Processed at the Same Time



The treated and untreated scallops were garnished with salt and pepper, lightly-breadcrumbsed and broiled side-by-side in a garlic butter for 10 minutes. Taste testing of the products indicated no difference in texture but the scallops that had been immersed for two days in the PAA-treated spent brine were reported to have a “slightly stronger fishy flavor.” This was hardly surprising considering that the Perasan MP-2-treated scallops had effectively been marinating in a spent processing brine that had an initial

strong odor of volatile amines. (the spent brine solution had been used to soak scallops for 4 days, plus 3 days of unrefrigerated transit time to our laboratories prior to this testing).

Peroxyacetic acid is unreactive to ammonia and some organic nitrogen compounds such as volatile amines. However, it has now been shown to be very effective against odor-causing microorganisms, and so malodor and taste issues would be expected to improve.

### Conclusions

- When used in accordance with FDA approvals, Perasan MP-2 is highly effective against aerobic bacteria and yeast and molds present in scallop-processing brine.
- The PAA from Perasan MP-2 afforded a  $\log_{10}$  5.86 reduction in aerobic bacteria after one hour representing 99.99986% depletion, and  $\log_{10}$  2.13 reduction in yeast and molds that is equivalent to a 99.280% decline.
- The PAA from Perasan MP-2 has sufficient persistency in the brine as to only require an additional one or two reapplications in order to prevent the microorganisms from rebounding during the maximum 4 day soak time. We suggest that Perasan antimicrobial ice™ would be a valuable alternative to re-charging the scallop-brine soak tank water.
- It is recommended that the brine tanks receive an initial charge of 100 ppm PAA using Perasan MP-2. Use test strips and reapply the product when the PAA concentration falls below 10 ppm. In order to keep the pH in the optimum 7-9 range the brine should be fortified with an additional amount of trisodium phosphate.
- PAA is unreactive to ammonia and organic nitrogen compounds such as volatile amines. However, its high degree of efficacy against odor-causing microorganisms would be expected to lead to reduced malodor and taste issues and would undoubtedly extend shelf-life.

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