

Oxidatively Induced Bathochromic Shift in Lobster Shell Astaxanthin via Peracetic Acid Treated Wash Water

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Background

Live lobster shells contain a pigment called astaxanthin (AXT) that is bound inside a complex macromolecular protein structure called crustacyanin (CR). CR bound AXT has an absorbance peak in the range of 630 nm, giving a grey-blue appearance. Upon exposure to high temperatures, such as during cooking, the CR structure is denatured which causes a bathochromic (red) shift, unbinding the AXT and moving the absorbance peak to the range of 470 nm, giving a deep red appearance.

Since 2007, Enviro Tech's peracetic acid (PAA) products have been approved in ice and wash water used to prepare seafood up to 190 ppm PAA, under food contact notification (FCN) 699. While a safe and efficacious antimicrobial treatment, no previous data was available evaluating if peracetic acid could cause oxidation of the CR structure and lead to a visible bathochromic shift in the raw lobster shell that may make the product appear as if it had been cooked.

Following an enquiry from a national Seafood producer, Enviro Tech was asked to investigate if this was possible, and if there was a critical concentration at which this phenomenon occurred.

Purpose

The goal of this study is to determine if Enviro Tech's MP-2 Peracetic Acid product could cause bathochromic shift of AXT in raw lobster shells at the typical dosage concentration of 50 ppm and at the federal maximum concentration of 190 ppm (per FCN 699), at both 5- and 10-minute contact times.

Materials and Methods

Two, ambient temperature 1.5-liter PAA solutions were prepared using 15% MP-2 (lot #825-102721-1), dosed to 50 ppm and 190 ppm, respectively. Concentrations were verified prior to submersion with the Palintest Kemio using sensor lot #PAA092003, and the pH of the solutions recorded:

Solution	Measured PAA Concentration	pH
50 ppm	51 ppm	3.93
190 ppm	193 ppm	3.53

Sample Testing

Photographs of the raw lobster tails were taken prior to submersion. Lobster tails were gently rinsed in fresh water to remove residue that may contribute to PAA demand and reduce concentration post-submersion. A lobster tail was added to the 50 ppm and 190 ppm solution while one remained unsubmerged as a control.

The tails were removed at 5 minutes, photographed and resubmerged for an additional 5 minutes. After 10 minutes the tails were photographed again.

Results

Figure 1 shows the lobster tails, top side and underside, after rinsing and prior to submersion. From left to right is control, 50 ppm and 190 ppm.

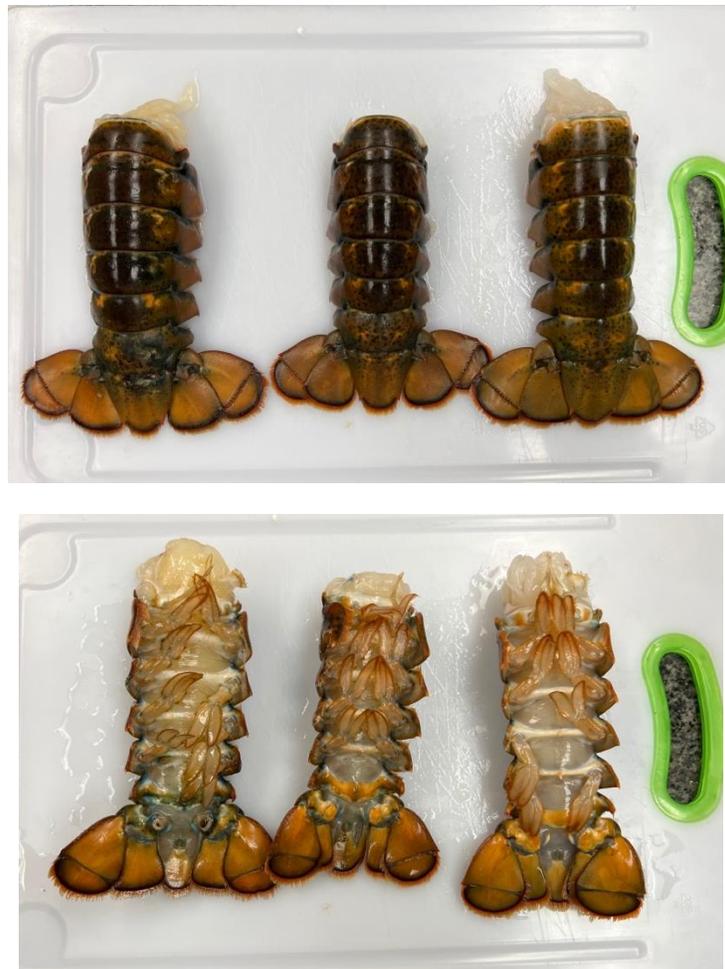


Figure 2 shows the lobster tails after 5 minutes of submersion. From left to right is control, 50 ppm and 190 ppm.



Figure 3 shows the lobster tails, top side and underside, after 10 minutes of submersion. From left to right is control, 50 ppm and 190 ppm.



Figure 4 shows a top-down view of the meat in the lobster tail after 10 minutes of submersion. Left to right is control, 50 ppm and 190 ppm.



Figure 5 shows a magnified comparative view of lobster tail #3 before submersion (left) and after 10 minutes of submersion (right) at 190 ppm.



Discussion

The results show that after 10 minutes, neither concentration induced any visible bathochromic shift in the lobster tails. This is highlighted most clearly in figure 5 which shows an expanded view of the lower left section of lobster tail #3 before and after a 10-minute submersion at 190 ppm PAA.

Figure 4 does show that after 10 minutes of submersion there is a significant whitening of the lobster tail meat in the 190 ppm PAA sample. This may indicate that PAA is able to denature proteins in the meat and while not harmful, this could be an undesirable change in product aesthetics.

Therefore, while no critical concentration or contact time is needed to prevent bathochromic shift in the shell, the producer may wish to limit the concentration to 50 ppm and less than 10 minutes of combined contact time to prevent whitening of the tail meat.