Antimicrobial and Organoleptic Effects of Aqueous Ozone on Pork Carcasses

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Materials:

10 sterile Whirlpak sample bags
10 sterile Butterfield's buffer (9ml)
6 sterile Butterfield's buffer (25ml)
6 sterile dehydrated sponge sample kits w/gloves
16 3M general aerobic Petrifilm
sharp sampling knife
spray bottle w/.01% hypochlorite solution
1ml pipetter
gram scale
Chemets Ozone Test Kit #K-7402
Ambient Ozone Monitor
Digital Camera

Methods:

1. Bring 5 carcasses (10 halves) into QA control using tags and ensure no further intervention on these carcasses occur after the high pressure wash.
2. Activate the ozone equipment (only qualified personnel) and adjust all settings to achieve the highest concentration of ozone possible.
3. Place ozone monitor in hot box and let flow from the spray wand occur into a drain for several minutes.
4. Using the Ozone Test Kit determine and record the concentration of ozone being emitted from the spray wand, then let flow occur in a drain again for several minutes and repeat the concentration test. Repeat this process until 2 consecutive concentrations are within approximately 0.5 ppm of each other. Record everything that you observed at this step.
5. Of the 5 carcasses in control, thoroughly coat 3 of the right halves and 2 of the left halves with ozone water so that at least one half of each carcass is treated. Do nothing with the other half of each carcass. Be sure to note the treated halves for later identification. Also note if ozone odor can be detected while spraying and record what the ambient ozone monitor in the hot box reads after spraying.
6. The morning of the following production day carefully compare and contrast the organoleptics of each treated carcass half to its untreated counterpart and record all observations. Take digital pictures to compare the treated and untreated halves.
7. Perform routine tissue sample collections from each of the 10 halves in the sample group and routine sponge sampling (i.e. ECPCV) of 6 halves from the first 3 carcasses in the group. Be sure to label all samples for later identification.
8. Plate all samples collected for mesophilic aerobic bacteria.

Results:

Ozone Concentration Tests (record time allowed to flow into drain and concentration)

- After 10 minutes of continuous flow concentration was 2.4 ppm.
- After another 10 minutes of continuous flow concentration was 2.6 ppm. Application of ozone on carcasses was performed at this point.
- At completion of the test with continuous flow concentration was 2.4 ppm. (A total of about 45 minutes)
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Results (cont.):

Carcass Identifications (write treated or untreated)

- Carcass #1 Right Half Treated Left Half Untreated
- Carcass #2 Right Half Treated Left Half Untreated
- Carcass #3 Right Half Treated Left Half Untreated
- Carcass #4 Right Half Untreated Left Half Treated
- Carcass #5 Right Half Untreated Left Half Treated

Can ozone odor be detected after spraying? No ozone odor detected.
What does the ambient ozone monitor read after spraying? 0.3 ppm (after 45 min spraying)

Organoleptics 24 Hours Post-Treatment (compare and contrast the treated half to its counterpart for each carcass and take pictures)
Number of hours post-treatment this observation is made = Approx. 24 hours

- Carcass #1 All carcasses can be described as having the following comparisons and contrasts:
- Carcass #2 Visual - Fat had a slightly lighter tint on the treated carcasses.
  - Muscle tissues were comparable.
  (see pictures at end of report)
- Carcass #3
  Texture/Firmness – No discernable differences.
- Carcass #4 Odor – No discernable differences.
- Carcass #5

Tissue Sample Bacteria Counts (cfu/gram)

- Carcass #1 Right Half: 13 Left Half: 36
- Carcass #2 Right Half: 10 Left Half: 57
- Carcass #3 Right Half: 21 Left Half: 76
- Carcass #4 Right Half: 68 Left Half: 14
- Carcass #5 Right Half: 15 Left Half: 9

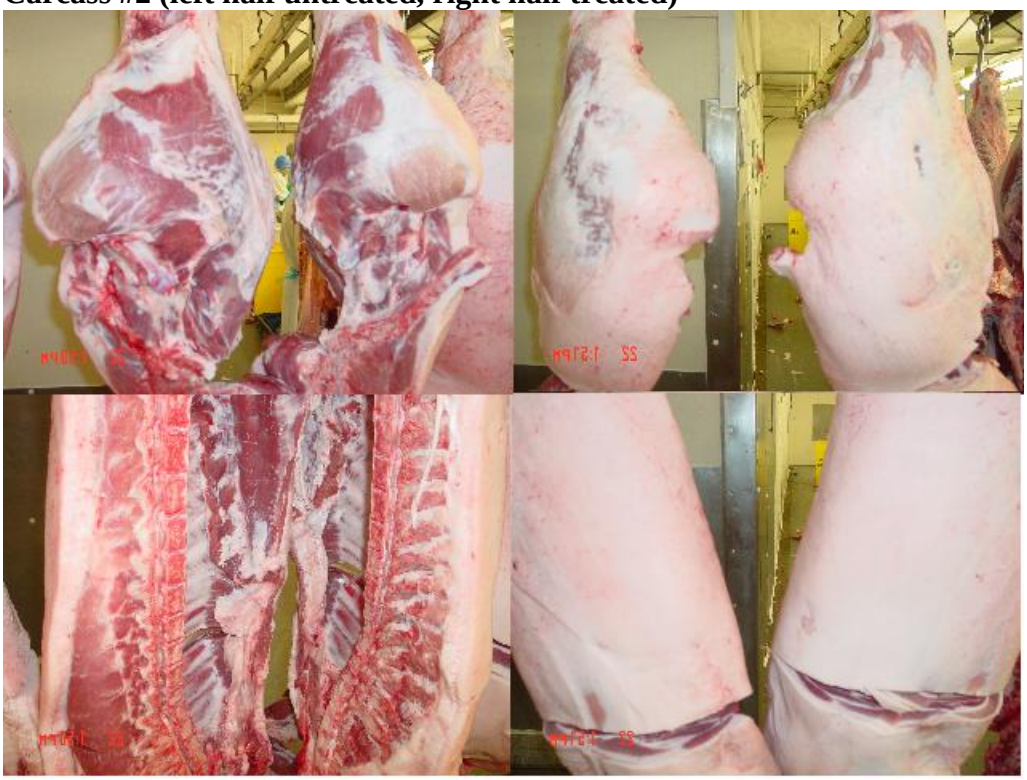
Sponge Sample Bacteria Counts (cfu/sq.cm.)

- Carcass #1 Right Half: Below LOD Left Half: Below LOD
- Carcass #2 Right Half: Below LOD Left Half: Below LOD
- Carcass #3 Right Half: Below LOD Left Half: 25

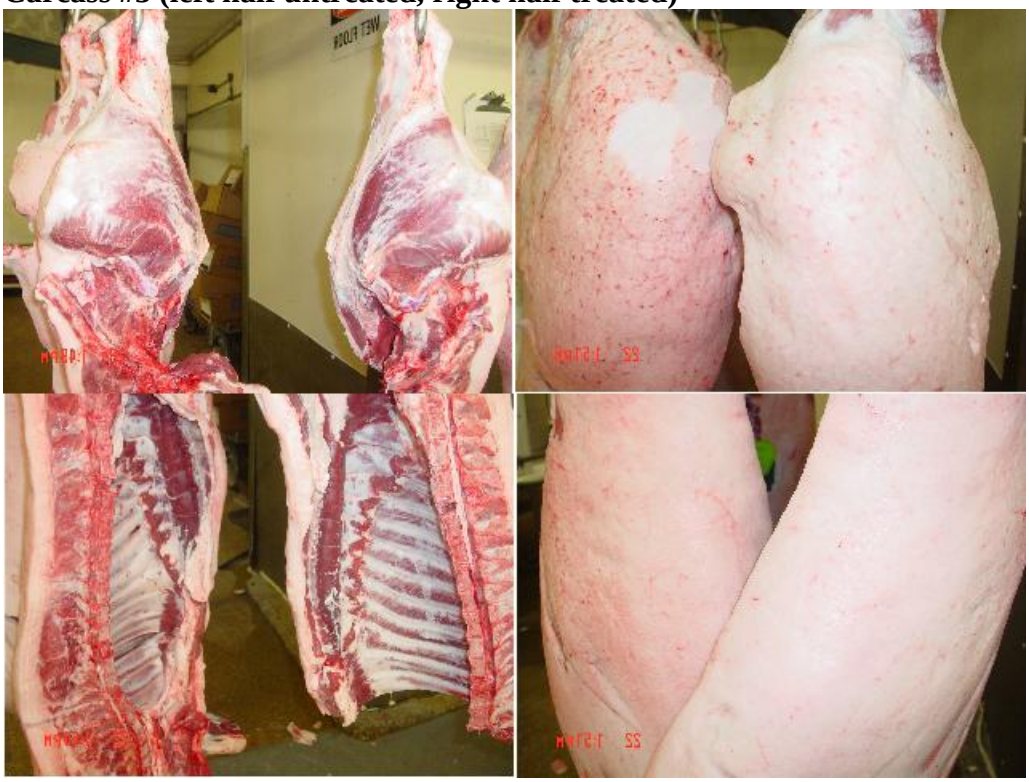
Note: The following pictures are of the left and right halves of a single carcass. Each individual picture has been oriented such that the true left half of the carcass is on the left side of each pair in the picture.

Carcass #1 (left half untreated, right half treated)

Carcass #2 (left half untreated, right half treated)

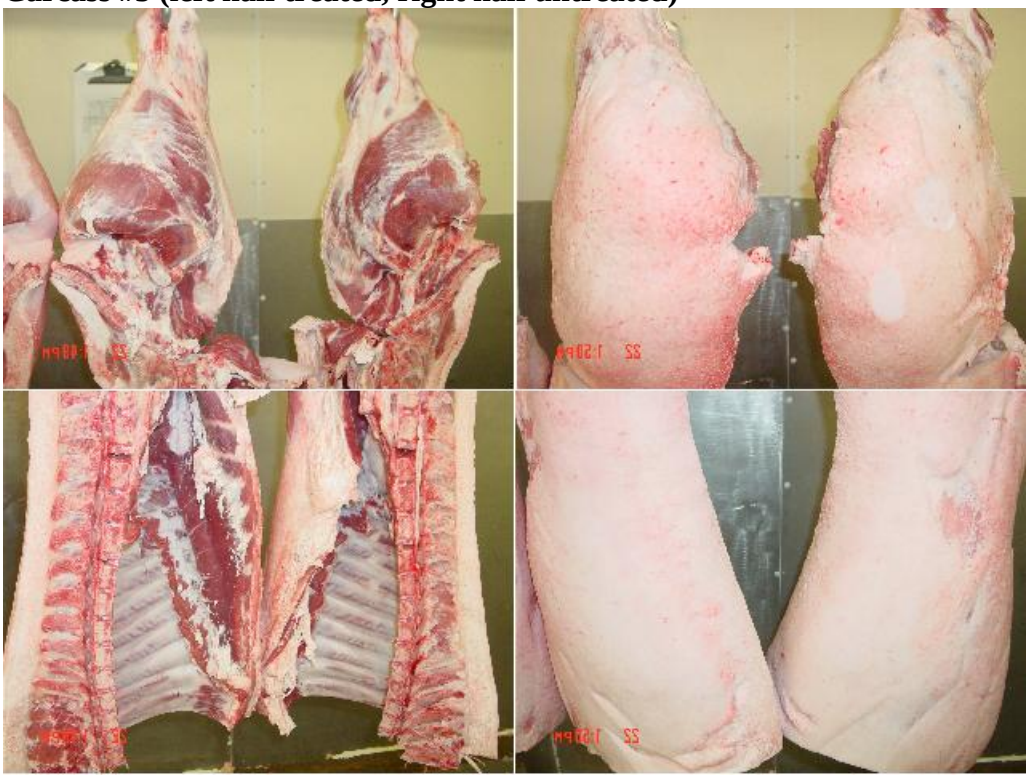


Carcass #3 (left half untreated, right half treated)



Carcass #4 (left half treated, right half untreated)

Carcass #5 (left half treated, right half untreated)



Discussion:

Carcass halves that were directly treated with aqueous ozone at a concentration of just over 2 ppm had an average of 67.6% decrease in microbial loads when compared to their untreated counterparts. The microbial loads of all carcass halves were relatively low when compared to carcasses not involved in this test and not proximal to the test carcasses. One explanation is that carcasses not directly sprayed with aqueous ozone were still subjected to misting (over spray) due to the nature of the spray wand tip and strong air currents in the area. All carcass halves were spaced apart from each other as far as possible (approximately 5 to 6 feet) but after continuous spraying in the area some misting began to circulate in the currents. Also, ambient ozone (gaseous, at 0.3 ppm) in the area after spraying could have been a factor affecting the microbial loads on all carcass halves.

The only discernable organoleptic difference between treated and untreated halves was that the fat on the treated halves had a slightly lighter tint to it than that of the untreated halves (see pictures). Both the Quality Assurance Department and Production Manager commented that the difference was not undesirable. The muscle tissues had no discernable differences at this concentration of aqueous ozone. It is hypothesized that the darkening of the fat color may increase with increased concentrations of aqueous ozone. It is not known if porcine muscle color would also darken with increased concentrations. For bovine muscle, this is in fact the case as other studies have shown.

Relative to employee safety, there was an ambient ozone concentration in the area of 0.3 ppm after 45 minutes of continuous flow from the spray wand. OSHA states that an employee may be subjected to 0.8 ppm ambient ozone for an 8-hour period. At higher ambient concentrations the allowed exposure time decreases. No odor of ozone was detected during the test. Although some of the literature states that ambient ozone can be smelled at a concentration of 0.2 ppm I did not detect any odor. I was wearing a mask that covers nose and mouth, which may have decreased my ability to smell.