

Results from tests at a Fortune 50 Pork Processing Company

The Effectiveness of Ozonated Water for Hard Surface Sanitation, Meat Cuts and Knife Dips – Microbial Kill Results

PURPOSE:

The goal of this analysis was to determine the effectiveness of ozonated water as a hard surface sanitizer, knife dip sanitizer, and microbial reducer on meat cuts. These tests used 3M petrifilm to acquire data on microbial load reduction. This media is non-selective and allow for enumeration of all aerobic viable microorganisms present. Samples were analyzed following 10-15 second spray washing. The testing was performed from 8/21/01 through 3/13/02.

MATERIALS AND METHODS:

Materials:

| | |
|---|--------------|
| Aqua Clean Mobile Sanitizer | Boots |
| Sterile Latex Gloves | Green Glove |
| 3M Aerobic Plate Count Petri Film | Air Knife |
| Automatic Pipetter | Wizard Knife |
| Permanent Marking Pen | Hock Cutter |
| Micro 90 Cleaner | Split Saw |
| Incubator, 34°C | Brisket Saw |
| Sterile 2ml Pipettes | 180°F Water |
| Sterile Transport Swabs with 10ml Lethen Broth | Tap Water |
| Hach Test Kit | Pig Foot |
| Steel Gloves | Pig Ear |
| Arm Guard | Pig Hide |
| Yellow Apron | Back Fat |
| Processing Belts | Jowls |
| Cutting Knives | Belly |
| Mezzanine Equipment (Final Grinder 5B, 6, 6B, 7, 8, 9 Hopper and Body) | Ham |
| Contact Plates | Shoulder |
| | Arm Pit |

Methods:

All experiments were conducted in present working environments consisting of both kill floor and production areas. Samples were categorized as PPE equipment (steel glove, arm guard, yellow apron, green glove), cutting knives, organic material (foot, ear, hide, meat cuts), Mezzanine equipment, and cutting equipment (air knife, wizard knife, hock cutter, split saw, brisket saw). Samples were sprayed with ozonated water for approximately 10-15 seconds with an ozone concentration of 1.1 ppm to 1.4 ppm. Comparisons of microbial counts were performed on samples:

- 1.) Before and after ozonation
- 2.) Ozone vs. 180°F water
- 3.) Ozone vs. 180°F water and cold water

4.) Ozone alone.

Swabbing was performed on all sample materials and transported to the microbiology laboratory. All samples were aseptically transferred to APC petrifilm and incubated for 48 hours. Counts were determined using a 10^{-1} dilution factor. Microbial counts 100 and greater were considered unacceptable.

RESULTS:

PPE Equipment – All PPE equipment that was tested showed a significant microbial reduction compared to before and after ozonation. A comparison of ozone vs. hot water on steel gloves showed that ozone performed better than 180°F water (Tables 1, 3, 5)

Cutting Knives – All cutting knives showed a significant microbial reduction compared to before and after ozonation. For ozone vs. 180°F water, both tests showed acceptable microbial reductions (Tables 2, 5, 8, 9).

Organic material – The contamination of pig ear, feet, and hide is extremely high, comparison of microbial counts before and after ozonation show a considerable reduction with some reduction to acceptable numbers. Various meat cuts taken from whole carcass showed significant acceptable microbial reduction (Tables 2, 3, 5, 6, 7).

Mezzanine Equipment – Ozonated water sprayed on hoppers and grinders in the mezzanine area showed similar results of microbial counts compared to standard methods of sanitation (Table 4).

Cutting Equipment - For comparison of ozone vs. 180°F water, ozone performed as good as or better in reducing microbial load than 180°F water. Microbial reduction was not observed for hock cutters for 180°F water but significant reductions were observed for ozone (Tables 10, 11, 12).

DISCUSSION

All areas, equipment, and samples tested for this evaluation were chosen based on the criteria of heavy microbial load. An overall trend of reduction was observed. The aqua clean mobile sanitizer did have a significant effect on reducing the microorganism load of all areas tested and sterilization of some areas was achieved. From these results ozone can be used as a substitution of 180°F water. Further experimentation will continue and the utilization of a permanent commercial ozone system enabling higher concentrations of ozone up to 3ppm will be used. Prediction of greater microbial reductions from higher ozone concentrations will be expected.

Table 1

| Testing of PPE with Ozone | | 8/21/2001 | |
|---------------------------|--|-----------|------------------------|
| Samples | | Control | Test (O ₃) |
| Steel Glove | | TNTC | 130 |
| Arm Guard | | TNTC | 230 |
| Apron | | TNTC | <10 |
| Blue Arm Guard | | TNTC | 70 |
| Belt 1 | | | <10 |
| Belt 2 | | | <10 |
| Belt 3 | | | <10 |
| Grease Fat on rail | | TNTC | <10 |

Table 2

| Ozone Test | 8/31/2001 | | | |
|-------------|-----------|---------|-----------|--------|
| Sample | BiTRACE | Control | 180 Water | Ozone |
| Knife | 500000 | TNTC | 4 | |
| Knife | 25034 | TNTC | 0 | |
| Knife | 44506 | TNTC | | 0 |
| Knife | 36101 | TNTC | | 3 |
| Knife | 4307 | TNTC | | *2 |
| Steel Glove | | TNTC | TNTC | |
| Steel Glove | | TNTC | | 2100 |
| Pig foot | | TNTC | | **TNTC |

*Swabs taken 10 minute after spray with ozonated water

** too numerous to count but significantly less than control

Table 3

| Testing of PPE with Ozone | | | 9/12/2001 |
|---------------------------|--|---------|------------------------|
| Samples | | Control | Test (O ₃) |
| Steel Glove | | TNTC | 290 |
| Steel Glove | | TNTC | 50 |
| Yellow Apron | | TNTC | 0 |
| Yellow Apron | | TNTC | 60 |
| Arm Guard | | TNTC | 10 |
| Green Glove | | TNTC | 100 |
| Pigs Foot | | TNTC | 10 |
| Pigs Ear | | TNTC | 1060 |
| Hand | | | 0 |

Table 4

Ozone Swab Testing of Mezzanine Equipment
9/19/2001

| Date | 8/15/ | 8/17 | 8/20 | 8/28 | 8/31 | 9/5 | 9/7 | 9/11 | 9/14 | 9/19 |
|--------------------|-------|------|------|------|------|------|------|------|------|------|
| 31 Hopper 5 | <10 | <10 | <10 | <10 | <10 | 290 | <10 | 50 | 570 | 10 |
| 32 Grinder 6 | 400 | TNTC | <10 | 20 | 290 | <10 | TNTC | <10 | 40 | <10 |
| 33 Hopper 7 | <10 | <10 | <10 | <10 | <10 | <10 | 10 | <10 | <10 | <10 |
| 34 Grinder 8 | <10 | <10 | <10 | 250 | TNTC | 50 | TNTC | <10 | <10 | <10 |
| 35 Link blend belt | <10 | <10 | <10 | 30 | <10 | TNTC | TNTC | <10 | 360 | <10 |

| | |
|--|-----------|
| | Ozone |
| | Sanitizer |

Table 5

| OZONE TESTING | | | 9/20/2001 |
|----------------------|--|----------------|-----------------------------|
| With knife sprayers | | | |
| Samples | | Control | Test (O₃) |
| Knife | | TNTC | 30 |
| Knife | | TNTC | 110 |
| Green Glove | | TNTC | 70 |
| Knife | | TNTC | 230 |
| Boots | | TNTC | 330 |
| Hand | | TNTC | <10 |
| Boots | | TNTC | 60 |
| Hand | | TNTC | <10 |
| Hide | | TNTC | 1500 |
| Hide | | TNTC | 300 |
| Yellow Apron | | TNTC | 90 |
| Green Glove | | TNTC | <10 |
| Knife | | TNTC | 60 |

Table 6

| Ozone Carcass Test | | | 10/11/2001 |
|---------------------------|----------------------|----------------|-----------------------------|
| Samples | Sample Number | Control | Test (O₃) |
| Back Fat | 1,2 | TNTC | 40 |
| Jowl | 3,4 | TNTC | 10 |
| Belly | 7,8 | TNTC | 120 |
| Belly | 9,10 | TNTC | 100 |
| Belly | 13,14 | TNTC | <10 |
| Belly | 15,16 | TNTC | 720 |
| Belly | 17, 18 | TNTC | 100 |
| Ham | 19,20 | TNTC | <10 |

Table 7

| Ozone Carcass Test | | | 10/17/2001 |
|--------------------|---------------|---------|------------------------|
| Samples | Sample Number | Control | Test (O ₃) |
| Belly | 1,2 | TNTC | 40 |
| Belly | 3,4 | 140 | 10 |
| Ham | 5,6 | 30 | 40 |
| Shoulder | 7,8 | 10 | 10 |
| Ham | 9,10 | 10 | <10 |
| Jowl | 11,12 | 50 | <10 |
| Jowl | 13,14 | TNTC | <10 |
| Belly | 15,16 | 340 | <10 |
| Jowl | 17,18 | 330 | <10 |
| Ham | 19,20 | <10 | <10 |
| Belly | 21,22 | 630 | <10 |

Table 9

| Ozone Knife Testing | | 11/12/2001 | | |
|---------------------|--|------------|-----------|-------|
| Samples | | Cold Water | Hot Water | Ozone |
| 1. Cutting Knife | | <10 | 20 | <10 |
| 2. Cutting Knife | | TNTC | <10 | TNTC |
| 3. Cutting Knife | | 30 | <10 | <10 |
| 4. Cutting Knife | | TNTC | 30 | <10 |
| 5. Cutting Knife | | 30 | <10 | <10 |
| 6. Cutting Knife | | 30 | <10 | <10 |
| 7. Cutting Knife | | TNTC | <10 | <10 |
| 8. Cutting Knife | | 50 | <10 | 30 |
| 9. Cutting Knife | | 180 | 40 | <10 |
| 10. Cutting Knife | | 110 | <10 | 20 |
| | | | | |
| Score | | 50% | 100% | 90% |

Table 10

| Ozone Knife Testing | 11/14/2001 | | |
|---------------------|------------|-----------|-------|
| Samples | | Hot Water | Ozone |
| 1. Air Knife | | <10 | 10 |
| 2. Air Knife | | 30 | 40 |
| 3. Air Knife | | <10 | <10 |
| 4. Air Knife | | 50 | <10 |
| 5. Air Knife | | 60 | 90 |
| 6. Wizard Knife | | <10 | 110 |
| 7. Wizard Knife | | 10 | 10 |
| 8. Wizard Knife | | 110 | 20 |
| 9. Wizard Knife | | 40 | 30 |
| 10. Wizard Knife | | <10 | 60 |
| | | | |
| Score | | 90% | 90% |

Table 11

| Ozone Knife Testing | 11/15/2001 | | |
|---------------------|------------|-----------|-------|
| | | | |
| Samples | | Hot Water | Ozone |
| 1. Hock Cutter | | TNTC | 130 |
| 2. Hock Cutter | | TNTC | 230 |
| 3. Hock Cutter | | 560 | 90 |
| 4. Hock Cutter | | 720 | <10 |
| 5. Hock Cutter | | TNTC | 150 |
| 6. Steel Glove | | TNTC | <10 |
| 7. Steel Glove | | 30 | 10 |
| 8. Steel Glove | | TNTC | <10 |
| 9. Steel Glove | | 170 | 10 |
| 10. Steel Glove | | 210 | 290 |
| | | | |
| Score | | 10% | 60% |

Table 12

| Ozone Knife Testing | 11/15/2001 | | |
|---------------------|------------|--------|-------|
| | | | |
| Samples | | Before | Ozone |
| 1. Split Saw | | TNTC | <10 |
| 2. Split Saw | | 330 | <10 |
| 3. Brisket Saw | | 210 | <10 |
| 4. Brisket Saw | | 470 | <10 |