Anti-Norovirus Efficacy of a Novel Levulinic Acid plus SDS-Based Sanitizer

Jennifer L. Cannon, Ph.D.
Center for Food Safety,
University of Georgia
November 7, 2012
Developed at UGA, Center for Food Safety

Effective against *Salmonella* and *E. coli* O157:H7

- Washing lettuce with 3% LVA with 1% SDS reduced populations by > 6 log cfu after 20 sec
- Applications on poultry carcasses and cages

Licensed as a produce wash solution

- FDA Generally recognized as safe (GRAS)
- Medical applications

Exploring for other applications

- Food contact surfaces
- Hand/glove sanitizer

Novel sanitizer composed of levulinic acid plus sodium dodecyl sulfate
Not effective against human norovirus surrogates when used individually in solution, but effective at low concentrations when combined.

Cannon et al, 2012; Journal of Food Protection 75(8);1532-5

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean (±SD) virus reduction (log PFU/ml)</th>
<th>Mean (±SD) virus counts (log PFU/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MNV-1</td>
<td>FCV</td>
</tr>
<tr>
<td>SDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.05%</td>
<td>−0.13 (± 0.26)</td>
<td>−0.12 (± 0.23)</td>
</tr>
<tr>
<td>0.5%</td>
<td>0.13 (± 0.20)</td>
<td>−0.09 (± 0.27)</td>
</tr>
<tr>
<td>1%</td>
<td>0.03 (± 0.12)</td>
<td>−0.05 (± 0.18)</td>
</tr>
<tr>
<td>2%</td>
<td>−0.23 (± 0.59)</td>
<td>−0.05 (± 0.22)</td>
</tr>
<tr>
<td>Levulinic acid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5%</td>
<td>0.09 (± 0.38)</td>
<td>0.09 (± 0.16)</td>
</tr>
<tr>
<td>1%</td>
<td>−0.04 (± 0.23)</td>
<td>0.32 (± 0.19)</td>
</tr>
<tr>
<td>2%</td>
<td>−0.06 (± 0.17)</td>
<td>0.51 (± 0.34)</td>
</tr>
<tr>
<td>3%</td>
<td>−0.09 (± 0.10)</td>
<td>0.43 (± 0.23)</td>
</tr>
</tbody>
</table>

<sup>a</sup> Counts below the detection limit of the assay are indicated as <2.70 log PFU/ml.

1 minute exposure time at room temperature
Purpose: to investigate the efficacy of three food-contact sanitizers against norovirus

* Treatment of food contact sanitizers:
  * 200 ppm chlorine prepared from household bleach
  * Alpet D2 undiluted
    * Quaternary ammonia compounds in 58.6% isopropanol
  * 5% levulinic acid plus 2% SDS
  * Water
  * Water plus 2% SDS

* Compare carrier test method to application methods that are more reflective of consumer use
  * Hydraulic spray
  * Electrostatic spray
  * Wet wipe
Hydraulic spray application

Spray:
2 passes: 6 sec each
Dispense: 600 mL/min at 43 psi
nozzle-to-target distance: 16 ½ inches

Neutralize and Elute

Plaque assay
Air-assisted, induction-charged (AAIC) electrostatic spraying

- a commercial, pneumatic-atomizing, electrostatic spray nozzle developed by Law

- spray droplet charge flow = -12 μA (lower for Alpet D2)
- flow rate = 100 mL/min
- 6 dual-pass sweeps
- volume median spray droplet
  - diameter = 30 μm
- nozzle-to-coupon distance = 76 cm

Spraying Applications
Wipe application

Wipe:
1000 (± 100) g force per 3.6 cm²

Neutralize and Elute

Mechanical wiping device

Plaque assay
Wiping action of mechanical device
Log reduction of infectious MNV-1 on stainless steel

- Sterile Tap Water
- Sterile Tap Water plus 2% SDS
- 5% LEV / 2% SDS
- 200 ppm Chlorine
- Alpet D2

Average Log Reduction (PFU/mL)

- cd
- d
- a
- c
- b
Log reduction of infectious MNV-1 on stainless steel

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average Log Reduction (PFU/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterile Tap Water</td>
<td>b</td>
</tr>
<tr>
<td>Sterile Tap Water plus 2% SDS</td>
<td>c</td>
</tr>
<tr>
<td>5% LEV / 2% SDS</td>
<td>a</td>
</tr>
<tr>
<td>200 ppm Chlorine</td>
<td>a</td>
</tr>
<tr>
<td>Alpet D2</td>
<td>c</td>
</tr>
</tbody>
</table>
Wiping with Saturated Towelettes

Log reduction of infectious MNV-1 on stainless steel

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average Log Reduction (PFU/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterile Tap Water</td>
<td>b</td>
</tr>
<tr>
<td>Sterile Tap Water plus 2% SDS</td>
<td>b</td>
</tr>
<tr>
<td>5% LEV / 2% SDS</td>
<td>a</td>
</tr>
<tr>
<td>200 ppm Chlorine</td>
<td>a</td>
</tr>
<tr>
<td>Alpet D2</td>
<td>b</td>
</tr>
</tbody>
</table>
The levulinic acid plus SDS sanitizer was at least as effective or more effective than chlorine for all application methods

* More effective as a hydraulic spray than chlorine

* Mechanical action improved virus removal/inactivation
  * Wipes were most effective for lev/SDS and chlorine
  * The evaporative nature of the Alpet D2 limited its use as a sanitizing wipe

* Cleaning surfaces with abrasion prior to sanitizing should be considered as a part of surface decontamination procedure

* Surface properties are also important to consider for sanitizer application
Acknowledgements

* Cannon lab
  * Stephanie Bolton
  * Grishma Kotwal
  * Ali Aydin
  * Amy Mann

* UGA collaborators
  * Mike Doyle
  * Tong Zhao
  * Mark Harrison
  * Ed Law

* Funding
  * Center for Food Safety at UGA
  * USDA, NIFSI
    * (2009-51110-20161)
  * USDA, NIFA, Food Virology Collaborative
    * (2011-68003-30395)