The effects of disinfectants in the processing water on pathogens in fresh produce

8 May 2014, Budapest

Jennifer Banach

WAGENINGEN UR
For quality of life

Content

- Disinfectant Testing Purpose
- Experimental Plan
- Results & Discussion (R&D)
- Summary
- Outlook

Purpose

- Fresh produce are vulnerable to pathogenic contamination (including cross contamination) during washing.
- Leafy greens are among the most frequently found fresh produce involved in outbreak incidents[1]

AIM

To evaluate the effects of disinfectants on pathogen presence during the washing of fresh produce.

WAGENINGEN UR
For quality of life

1) EFSA Journal 2013;11(1):3025

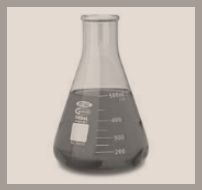
Experimental Plan

- Pathogens
    1) *Escherichia coli* – ESBL Human isolate
    2) *Salmonella enterica* Typhimurium – isolate from lettuce
- Disinfectants
    1) Chlorine dioxide (5ppm)
    2) Silver/copper (9 ppm Ag/ 1 ppm Cu)
    3) Sodium hypochlorite (10ppm)
    4) Tap water
- Experiments
    1) Water
    2) Product (leaf and washing water)

"Stressed" culture 5°C

24h, 5°C

LB overnight culture 37°C



10^5 cfu/punch

Punch with inoculum 1h

Inoculum removed

1

10^5 cfu/ml
0-20 min.
5°C

2

2 min.
5°C & 20°C

Crush

Rinse

Treatment

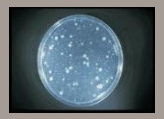
(Disinfectant Applied)

'Water'

Concentration after 0-20 min.

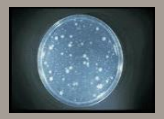
Inactivation efficiency in washing water

'Leaf'



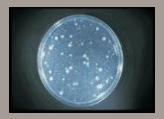
Effect of pathogens on the product

'Wash'



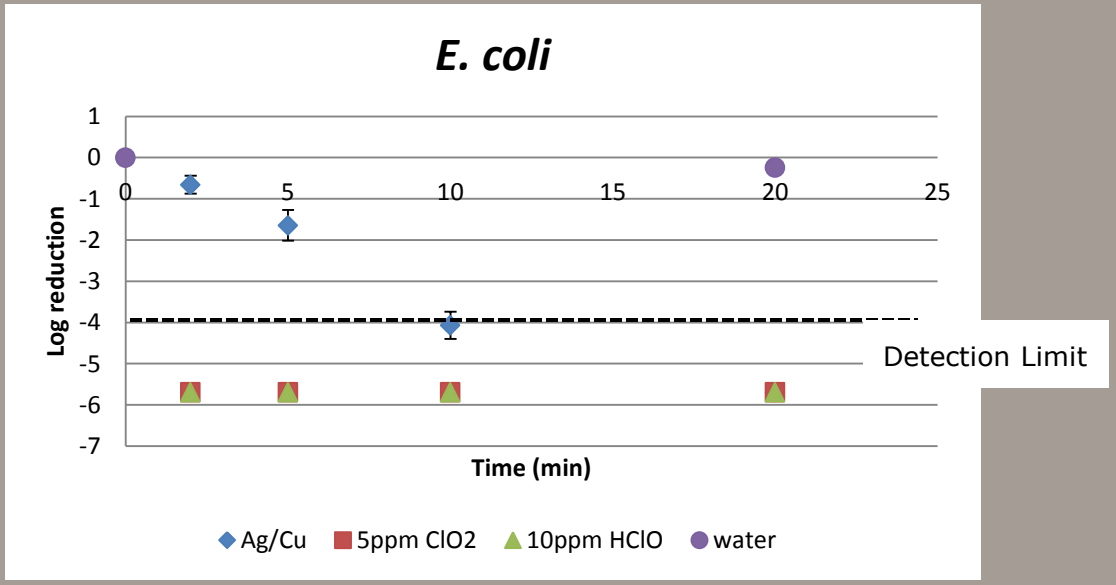
Releasing efficiency of pathogens on leaf (potenital cross-contamination)

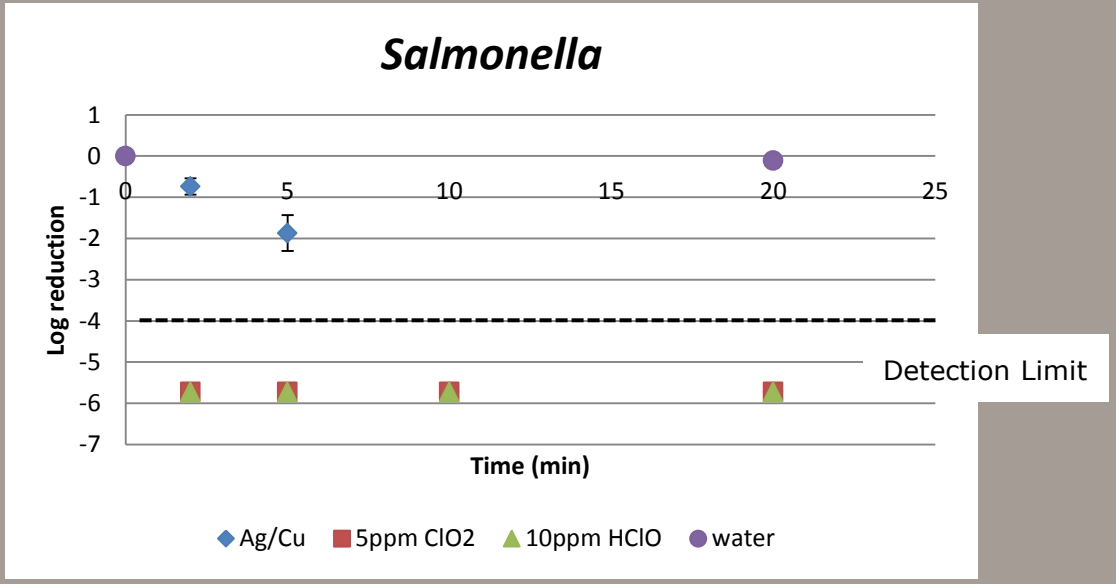
'Filter'



Control

R&D 1: Inactivation in washing water (5°C)

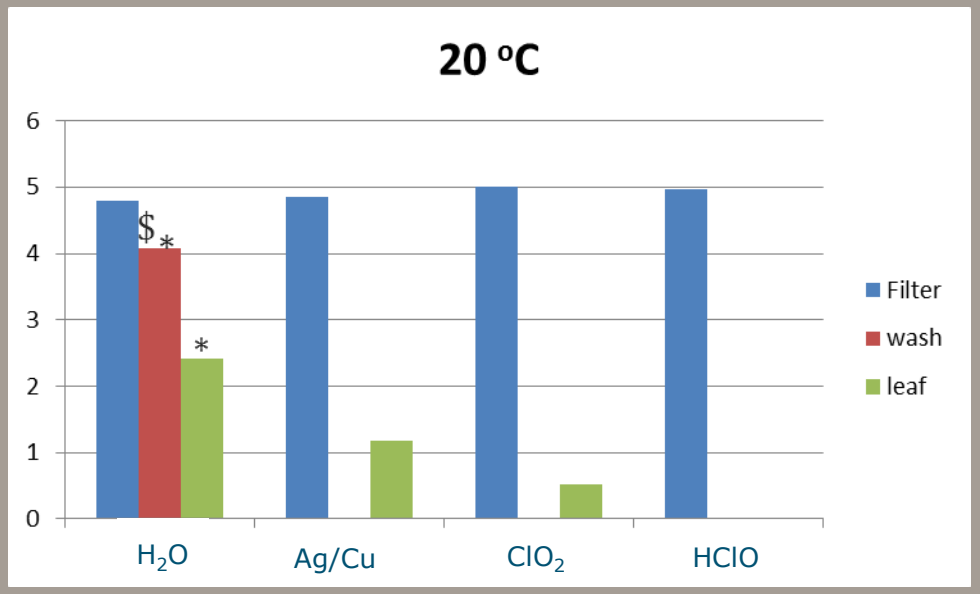


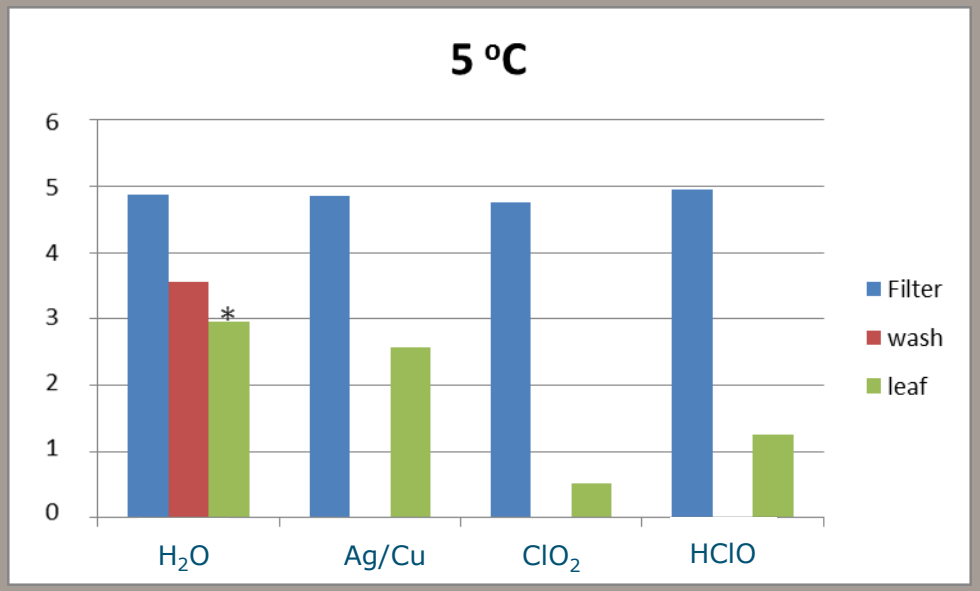


For overnight (left) and stressed (data not shown) cultures:

- All 3 disinfectants inactivate the tested pathogens.
- For the tested pathogens, there is a 4 log reduction for ClO_2 and HClO.
- For the Ag/Cu disinfectant, there is a 4 log reduction with a 10 minute contact time for *E. coli* and *Salmonella*.
- Few differences between overnight and stressed cultures.
- The stressed *E. coli* may survive better towards Ag/Cu (large SD).

R&D 2a: Deactivation on lettuce (*E. coli*)



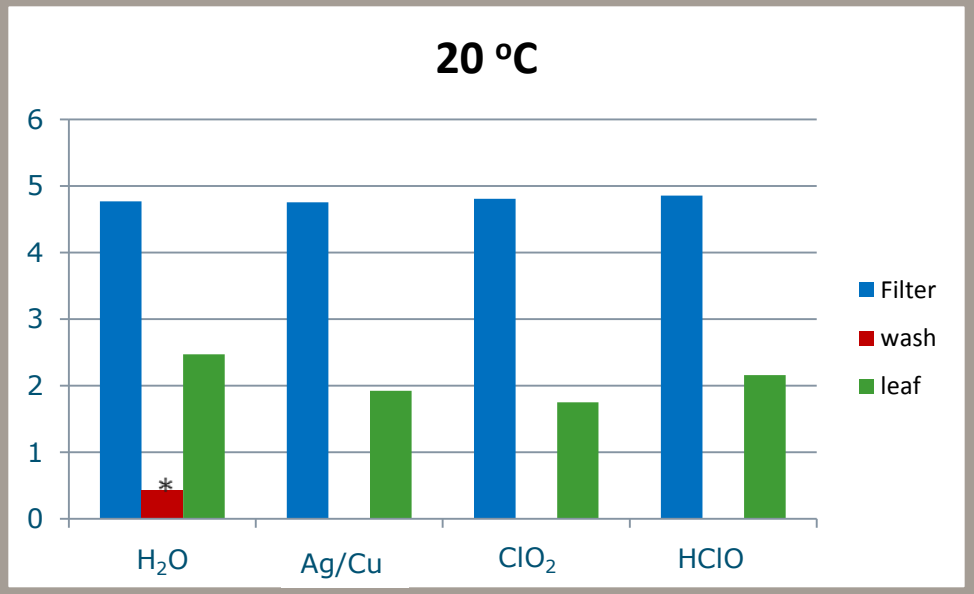


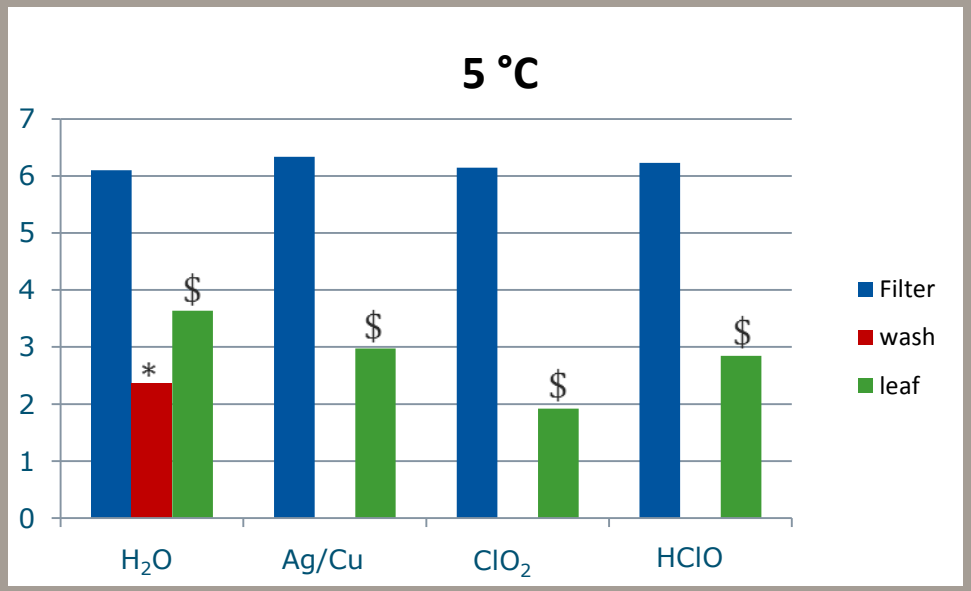
- Treatments are effective in inactivating *E. coli* in wash water at both T.
- Treatments had some effect on *E. coli* numbers that attached to the leaf, yet not a complete elimination.

* sign. higher (between treatments)

$ sign. higher (between temperatures)

R&D 2b: Deactivation on lettuce (*S. enterica*)





- Treatments are effective in inactivating *S. enterica* in wash water at both T.
- Treatments had some effect on *S. enterica* numbers that attached to the leaf, yet not a complete elimination.
- Cell attachment to leaf surfaces is better in comparison to *E. coli*.
- Cell attachment to lettuce leaf surface is better at 5°C than 20°C.

* sign. higher (between treatments)

$ sign. higher (between temperatures)

Summary

- All 3 disinfectants inactivate the tested pathogens in water (5ºC).
  - Ag/Cu is less effective than chlorine and chlorine dioxide.
- There are few differences visualized in the overnight stressed cultures.
  - However, the 'stressed' *E. coli* may survive better against Ag/Cu.
- All 3 disinfectants are effective in inactivating the tested pathogens in wash water at both temperatures (5ºC and 20ºC).
- Pathogen inactivation in the wash water and on lettuce:
  - Ag/Cu is less effective on the lettuce leaves than chlorine or chlorine dioxide (*E. coli*).
  - Cell attachment to leaf surfaces is better in *S. enterica* than *E. coli.*
  - In *S. enterica,* there is better attachment to the lettuce leaf surface at 5ºC than 20ºC.

Outlook 2014 and beyond

- Effects of disinfectants on pathogen presence with organic loaded water
- Growth of micro-organisms post-contamination of the product after washed with the disinfectant
- Pilot plant set-up
- Modelling the effects (pros and cons) of disinfection of the washing water on public health

Thank you for your attention!

This work was performed in collaboration with:

Hermien van Bokhorst-Van de Veen[1]
Masja Nierop Groot[1]
Leo van Overbeek[2]
Cees Waalwijk[2]
Eelco Franz[3]
H.J.(Ine) van der Fels-Klerx[4]

and the following partners:

The Dutch Fruit and Vegetable Industry
The Ministry of Economic Affairs, The Netherlands

WAGENINGEN UR
For quality of life

1) FBR Wageningen UR, Wageningen, Netherlands
2) PRI Wageningen UR, Wageningen, Netherlands
3) RIVM, Bilthoven, Netherlands
4) RIKILT Wageningen UR, Wageningen, Netherlands