Improving Produce Safety by Stabilizing Chlorine in Washing Solutions with High Organic Load

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Introduction

Chlorine is widely used by the fresh and fresh-cut produce industry to reduce microbial populations and prevent pathogens cross-contamination during produce washing. However, the organic materials released from cut produce react with chlorine and degrade its efficacy for pathogen inactivation. A chlorine stabilizer usable in produce wash systems with high organic load could greatly improve produce safety.

Objectives

- Evaluate effectiveness of T-128 to stabilize chlorine in the presence of a high organic load and foreign materials typical of commercial fresh-cut produce wash operation conditions.
- Determine the dynamic changes of wash water quality and free chlorine concentration during leafy green wash processing, and the consequential results on pathogen survival in the wash solution and the potential for cross-contamination, with or without T-128.

About T-128

WHAT - T-128 is a chemical mixture formulated by New Leaf Inc. containing GRAS food ingredients.

HOW – T-128 is substituted for citric acid to adjust pH to the desired level (3.5 – 5.5).

WHY – T-128 is intended to slow down the degradation of free chlorine in the presence of a high organic load during commercial fresh-cut produce wash operations.

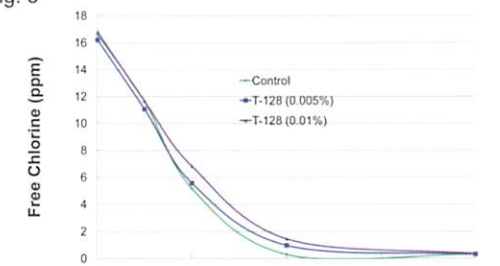
Fig. 1. A pilot plant trial system with T-128 dosing equipment

Results

Fig. 2

Figure 2 demonstrates that T-128 significantly reduced the soil generated degradation of free chlorine in the wash solution, compared to the control (chlorinated water without T-128).

Fig. 3



Juice (%)	0.00	0.50	1.00	1.50	2.00
COD (mg/L)	63	325	532		942
Turbidity	0.43	4.74	9.04		16.85

Figure 3 suggests that T-128 slightly reduced the loss of free chlorine caused by reaction with lettuce exudates. The organic load in the wash solution was measured in terms of percent lettuce juice, chemical oxygen demand (COD) and turbidity (NTU).

Table 1.

Treatment	Lettuce juice (%)	Free Chlorine (ppm)	*Salmonella* Typhimurium	*E. Coli* O157:H7
Control	0	16.2	ND	ND
	0.25	11.6	ND	ND
	0.5	4.75	ND	ND
	1.0	0.26	1.30	1.70
	2.0	0.29	2.04	2.00
T-128 (0.01%)	0	16.65	ND	ND
	0.25	12.3	ND	ND
	0.5	6.95	ND	ND
	1.0	2.2	ND	ND
	2.0	0.41	ND	ND

Data in Table 1 shows that residual free chlorine decreased rapidly with increase in organic load (lettuce juice). When juice concentrations reached 1-2 % (Fig. 3), free chlorine levels in the control dropped below 0.3 ppm, resulting in pathogen survival; however, when T-128 was added, pathogen survival was not detected (ND).

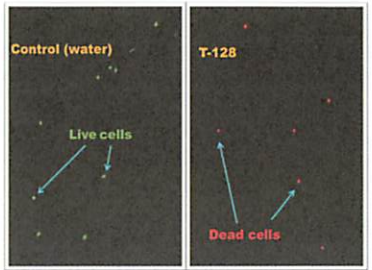


Fig. 4. Laser confocal images of live (green) and dead (red) *E. coli* cells in suspension. This picture demonstrates that T-128 itself has a weak bacteriocidal effect; at high concentration and extended reaction time T-128 can cause *E. coli* inactivation.

Summary

The addition of T-128 to the chlorinated wash solution significantly reduced the potential for pathogen survival and mitigated the risks of solution-mediated cross-contamination in presence of high organic load and soils.

Future Goals

- Determine efficacy of T-128 to reduce pathogen survival and transference in chlorinated wash water processing of herbs, tomatoes, and cantaloupes.
- Evaluate impact of T-128 on produce quality and shelf life.