Control of *Listeria monocytogenes* on avocado and avocado contact surfaces during dry packing by acetogenins naturally present in avocado seed

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Project funding dates

January 1, 2024 – December 31, 2024

Acknowledgements

We are indebted to the Texas International Produce Association for support, to Giumarra Co. for generously supplying avocados and guidance on avocado handling, and the Mexican avocado industry for providing avocado seed. Thanks to the Tecnológico de Monterrey and Texas A&M research teams for invaluable assistance and diligent work; and to Jorge Abraham Clorio Carillo and Diana Sánchez Rodríguez of Monterrey Tech. for technical support in the experimental work.

Summary

Lauraceous acetogenins are fatty acid derivatives found in avocados and avocado seeds, and possess multiple beneficial effects and show antimicrobial activity against gram-positive bacteria, including *Listeria monocytogenes (LM)*. The antimicrobial effect of an extract of avocado seed enriched with lauraceous acetogenins and mixed in avocado oil (ACE oil) is being evaluated as a potential control measure to reduce *LM* on avocados during the packing process, and applied by different methods. Experiments at this time show a 2.4 log reduction after coating avocados with ACE oil by dripping the coating on the rind of inoculated avocados. Trials on optimization of extraction and concentration of ACE, challenge studies testing various concentrations of extract in the ACE oil, and shelf-life studies on coated avocado are underway.

Objectives

1. Evaluate the ability of the acetogenin-enriched (ACE) extract to reduce *LM* on avocado surfaces in a simulated dry packing operation.
2. Evaluate the effectiveness of the ACE extract at reducing cross-contamination with *LM* after contact with contaminated packing equipment.
3. Study metabolic responses of avocados to the coating with ACE extract.

Methods

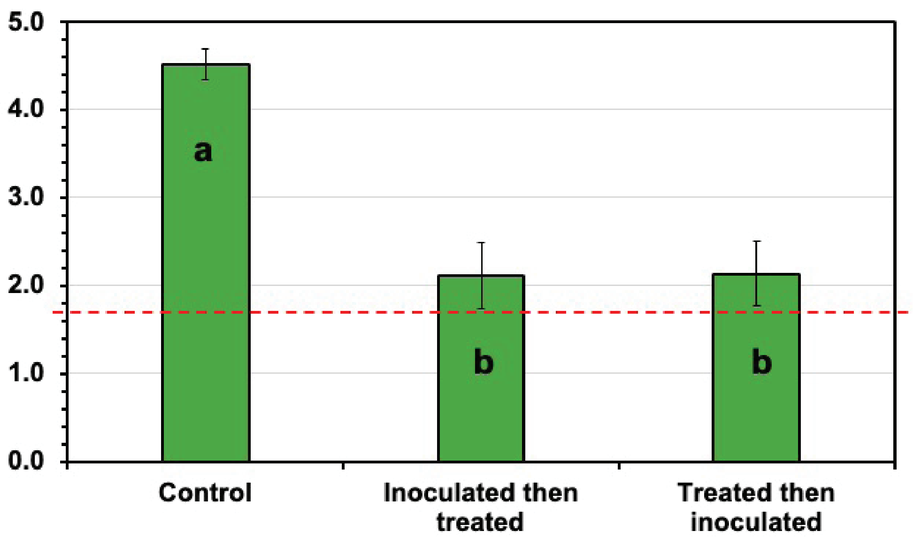
- For Objective 1, Hass avocados are surface inoculated with *LM*, then coated with ACE oil. The factors to test are: (i) lauraceous acetogenin concentration in the ACE extract, where coatings containing 7,000–14,000 mg/kg of the active compound will be applied, and (ii) the coating application by dripping and brushing, misting, or spreading with sponge-covered rollers. Separately, Hass and Green-Skin avocados will be inoculated and coated to test the effect of skin roughness on the effectiveness of ACE oil during storage.
- In Objective 2, Hass and Green-Skin avocados will be coated with ACE oil, then exposed to inoculated surfaces; the numbers of transferred *LM* will be determined by plate counts.
- In Objective 3, avocados will be coated and stored to measure the effect of ACE on shelf life and fruit metabolism.

Results to Date

The reduction of *LM* on Hass avocados was determined to be 2.4–2.7 log CFU/cm² when treated with coating containing 10,000 mg/kg lauraceous acetogenins (**Figure 1**). In ongoing trials, the presence of lauraceous acetogenins in the coating has resulted in a significant reduction compared to coating with avocado oil alone. There were no differences in reductions of *LM* on Hass avocados between concentrations of 7,000, 10,000 and 14,000 mg/kg in the ACE oil, or between the methods of coating application (brushing, misting or buffing with ACE oil–impregnated sponge rollers) (**Table 1**).

Benefits to the Industry

The data collected in this proof-of-concept project should contribute information for the implementation of alternative steps to complement the strict sanitation with an additional control measure against *LM*. The ever-growing avocado market, especially between Mexico and USA, will benefit from this improvement that is tied with previous research to offer a holistic approach to pathogen prevention and control on avocados, coupled with the environmental benefit by using byproducts that are currently perceived as waste. This environmental benefit is expected if the enormous amounts of avocado seeds are kept away from trash dumpsters, and should also result in an economic benefit by bringing an application to this waste, creating jobs and markets. Anticipated food safety benefits, assuming this project is successful, include the possibility of establishing a kill step for fresh avocado that would be groundbreaking.



***Effect of fruit coating with acetogenin-enriched oil on the reduction of* Listeria monocytogenes *on whole avocados.* Error bars indicate SEM. Dotted line indicates the minimum detection level (1.7 log/cm²). Columns with same letter are not different (P < 0.05).**

Table 1. Effect of the concentration of laureaceous acetogenins and the method of application of ACE oil on the reduction of *Listeria monocytogenes* on inoculated Hass avocados.

ACE Concentration (mg/Kg)	Application Method	Log CFU/cm²[a]	Estimated log reduction
0	Brush	4.2 A[b]	N/A
	Mist	5.0 A	N/A
	Rollers	4.7 A	N/A
7,000	Brush	1.5 B	2.7
	Mist	1.8 B	2.4
	Rollers	1.6 B	2.6
10,000	Brush	1.8 B	2.4
	Mist	2.4 B	1.8
	Rollers	2.4 B	1.8
14,000	Brush	1.8 B	2.4
	Mist	2.3 B	1.9
	Rollers	1.9 B	2.3

[a] SEM = 0.304
[b] Values followed by the same letter are not significantly different (P < 0.05)