




“Laser Labeling for Citrus; Approved by FDA ”

Ed Etxebarria, UF-CREC
Michelle Danyluk, UF-CREC
Jan Narciso, USDA





Labeling with low energy Carbon dioxide laser beam

- Permanent Label
- Labeling information changed quickly
- Clean
- No storage Needed
- Traceback (must be human readable)






Laser labeling machine

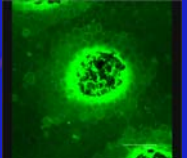


FDA interested in the effect of laser labeling on Citrus fruit quality and safety during storage


SEM



SLCM

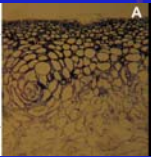
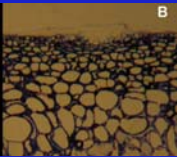



Label based on a shallow scratch on the waxy cuticle



FLAVEDO →

ALBEDO →



Three part study:

- I. Optimization
- II. Decay studies
- III. Safety studies



I. Optimizing laser energy for minimum tissue exposure to reduce water loss and preserve aesthetics

30 μm 35 μm 45 μm
55 μm 70 μm 85 μm
95 μm 105 μm 120 μm

UF UNIVERSITY of FLORIDA
IFAS
Tissue Research and Education Center

Water loss

Energy (μm)	Evaporation rate (mmol/m²/h)
35	~1.5
45	~2.5
85	~3.5
120	~4.0

UF UNIVERSITY of FLORIDA
IFAS
Tissue Research and Education Center

Post-label waxing

UF UNIVERSITY of FLORIDA
IFAS
Tissue Research and Education Center

Rate of water loss

Time after labeling (h)	Unwaxed label	Waxed label	Control
0	~3.5	~0.5	~0.5
24	~2.5	~0.5	~0.5
48	~1.5	~0.5	~0.5
72	~1.0	~0.5	~0.5
96	~0.8	~0.5	~0.5
120	~0.7	~0.5	~0.5
144	~0.6	~0.5	~0.5

UF UNIVERSITY of FLORIDA
IFAS
Tissue Research and Education Center

Waxes

Waxes	% decrease in evaporation rate
Control 100	~100
Pure Carnauba	~95
Dole Wax	~90
DG Carnauba	~85
100% Carnauba	~80
Carnauba Blend	~75
Shell	~70
Control 111	~65
Control 120	~60

UF UNIVERSITY of FLORIDA
IFAS
Tissue Research and Education Center


II. Natural Decay

Time after labeling (weeks)	control	35μm	45μm	65μm	120μm
1	~0	~0	~0	~0	~0
2	~2	~3	~4	~5	~6
3	~4	~5	~6	~7	~8
4	~6	~7	~8	~9	~10
5	~10	~11	~12	~13	~18


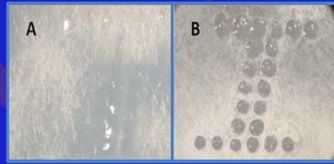



Storage at 45°F and 80°F, 94% RH

UF UNIVERSITY of FLORIDA
IFAS
Tissue Research and Education Center

Challenged Decay
Penicillium spores on unwaxed labeled area,
 incubated under above conditions




Penicillium did not penetrate label











III. Food Safety (main FDA concern)

- FDA main concern: “does natural-light labeling change the colonization, infiltration and survival of pathogens on the surface of produce?”
- Evaluate the potential for *Salmonella* to internalize into citrus fruits following natural-light labeling




Oranges: Valencia oranges
 Laser: Etched for 35 μs with

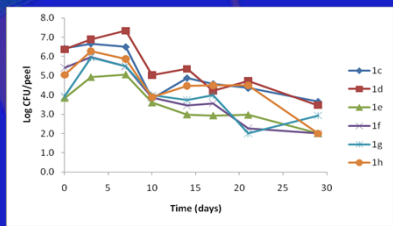






Juice Results

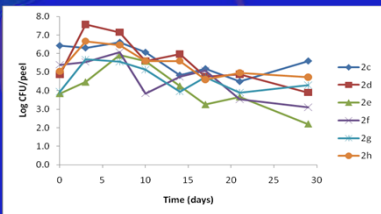

No *Salmonella* isolated in juice samples of sound fruit for all treatments, controls and storage temperatures.



Peel Results: 10°C





Peel Results: 26°C

There were no significant differences ($P < 0.05$) between populations of *Salmonella* on laser labeled or unlabeled oranges, regardless of wax application, stored at 10, or 26 °C

Laser labeling did not facilitate *Salmonella* infiltration into orange juice



Conclusions



Laser labeling does not adversely affect the citrus surface with respect to decay organisms, pathogen survival or infiltration, and offers industry a permanent, safe alternative to traditional adhesive labeling.

