"Laser Labeling for Citrus; Approved by FDA "

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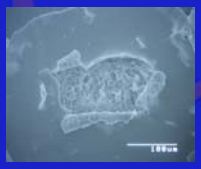
Labeling with low energy Carbon dioxide laser beam

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

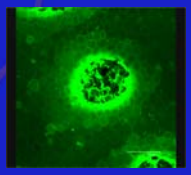
Laser labeling machine

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

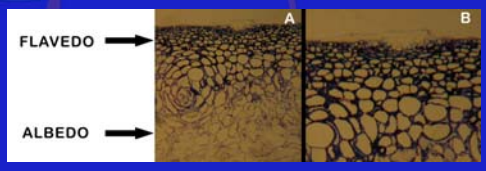
SEM



SLCM



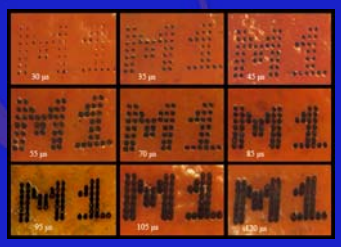
Label based on a shallow scratch on the waxy cuticle



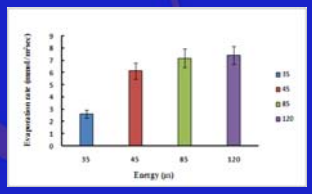
Three part study:

I. Optimization
II. Decay studies
III. Safety studies

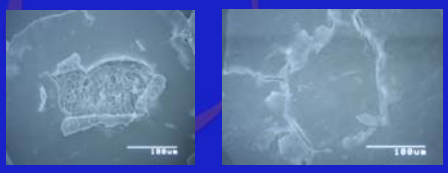
I. Optimizing laser energy for minimum tissue exposure to reduce water loss and preserve aesthetics



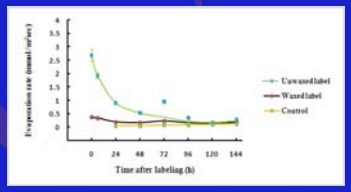
Water loss



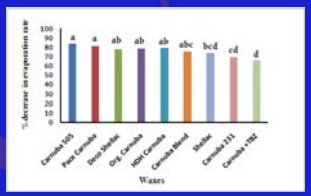
Post-label waxing



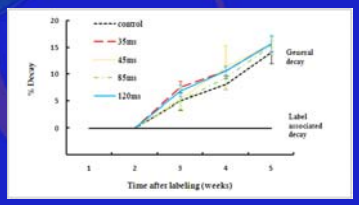
Rate of water loss



Waxes



II. Natural Decay

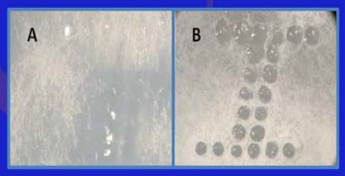


Storage at 45°F and 80°F, 94% RH

Challenged Decay

Penicillium spores on unwaxed labeled area, incubated under above conditions

Penicillium did not penetrate label



III. Food Safety (main FDA concern)

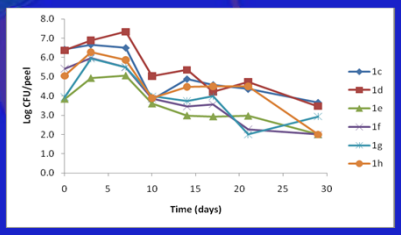
- FDA main concern: "does natural-light labeling change the colonization, infiltration and survival of pathogens on the surface of produce?"
- Evaluate the potential for *Salmonella* to internalize into citrus fruits following natural-light labeling

Oranges: Valencia oranges
Laser: Etched for 35 µs with

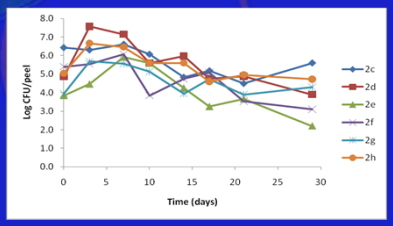
Juice Results

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.