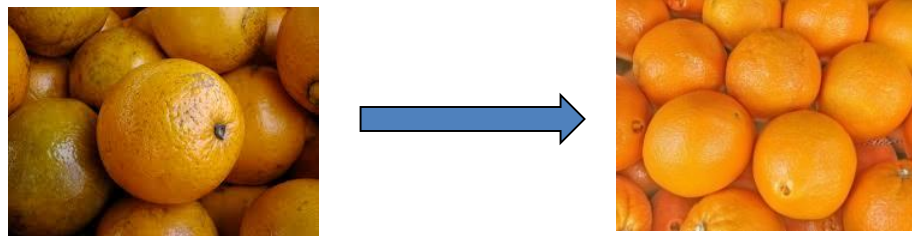


# Research Update: natural colorants to improve skin color of fresh citrus



Jinhe Bai <sup>a</sup>, Xiuxiu Sun <sup>a</sup>, Elizabeth Baldwin <sup>a</sup>, Anne Plotto <sup>a</sup>, Mark Ritenour <sup>b</sup>

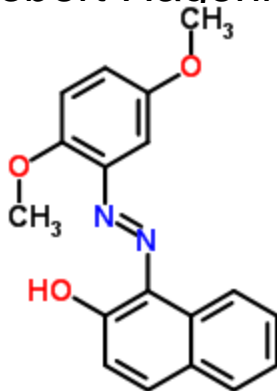
<sup>a</sup> USDA, ARS, USHRL, Ft. Pierce, FL 34945

<sup>b</sup> Indian River Research and Education Center, University of Florida, Ft. Pierce, FL 34845

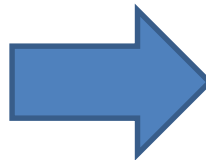
# Introduction



- Initiation of the project to search an alternative to Citrus Red Number 2
  - Request from Peter Chairs to Dr. Liz Baldwin, USDA-ARS research leader in 2013
  - Meetings between the citrus packers and our research group (2015 and 2016)
  - Special thanks to Dr. Xiuxiu Sun (research associate) and Dr. Robert Hagenmaier (retired USDA scientist, Technical adviser).



CR2



# Challenges

## 1. Solubility

- Soluble in pine oil, however, it is extremely difficult to make an application dilution in water.
- What did we do: make an emulsion/microemulsion.

❖ **Once added to water, the solution becomes gelatinous and can harden**



In pine oil



# Challenges

## 2. Color stability

Fading of color when exposed to AIR

❖ **Oxidation of carotenoids**



Day 0



Day 1



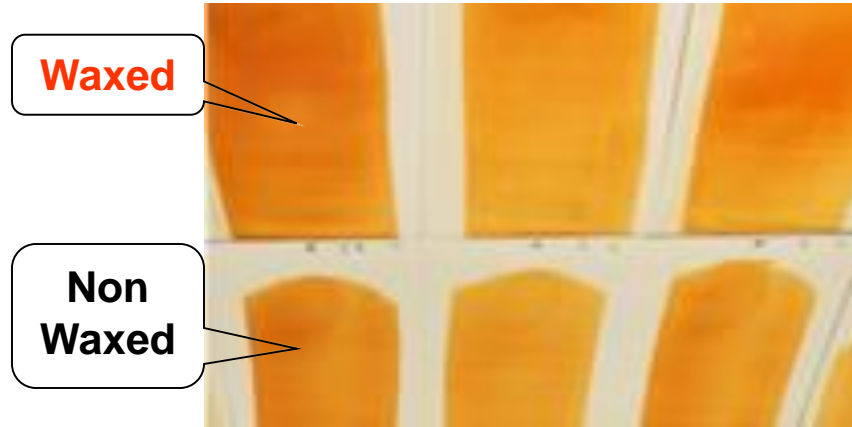
Day 2



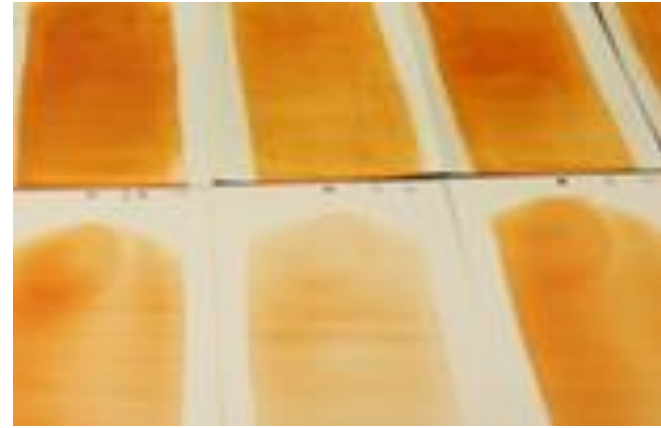
Day 7

# What did we do to protect the color from fading?

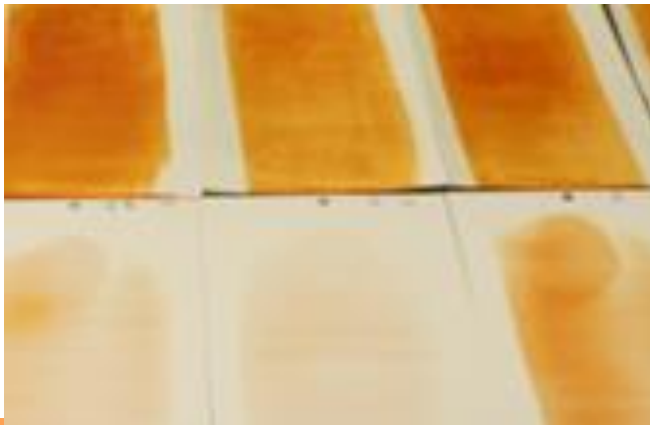
- Incorporated the colorant into wax



Day 0



Day 1

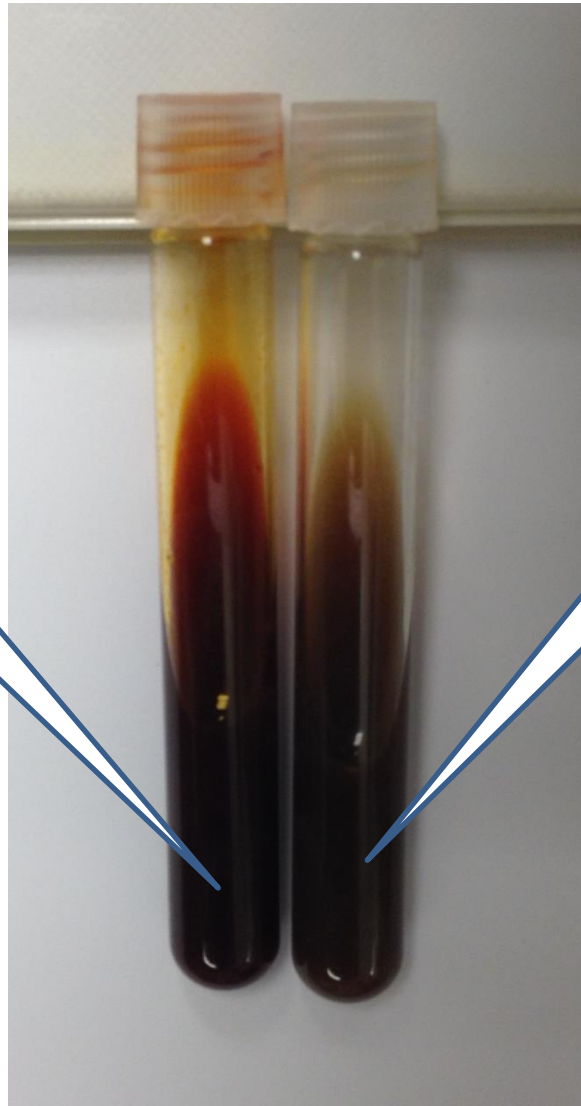


Day 2



Day 7

# Colored wax coating

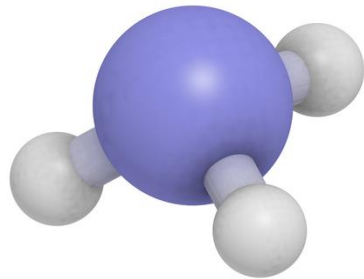


**Annatto+  
Carnauba  
wax**

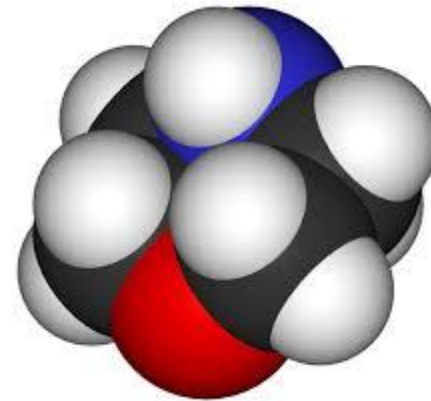
**Carnauba  
wax**

## New challenge of color fading:

- Experimental wax: morpholine was used and color fading is no longer a problem.
- Commercial wax: when replace morpholine by ammonia in the commercial formulation, color fading remains problematic.



Ammonia



Morpholine





Annatto

Citrus red 2

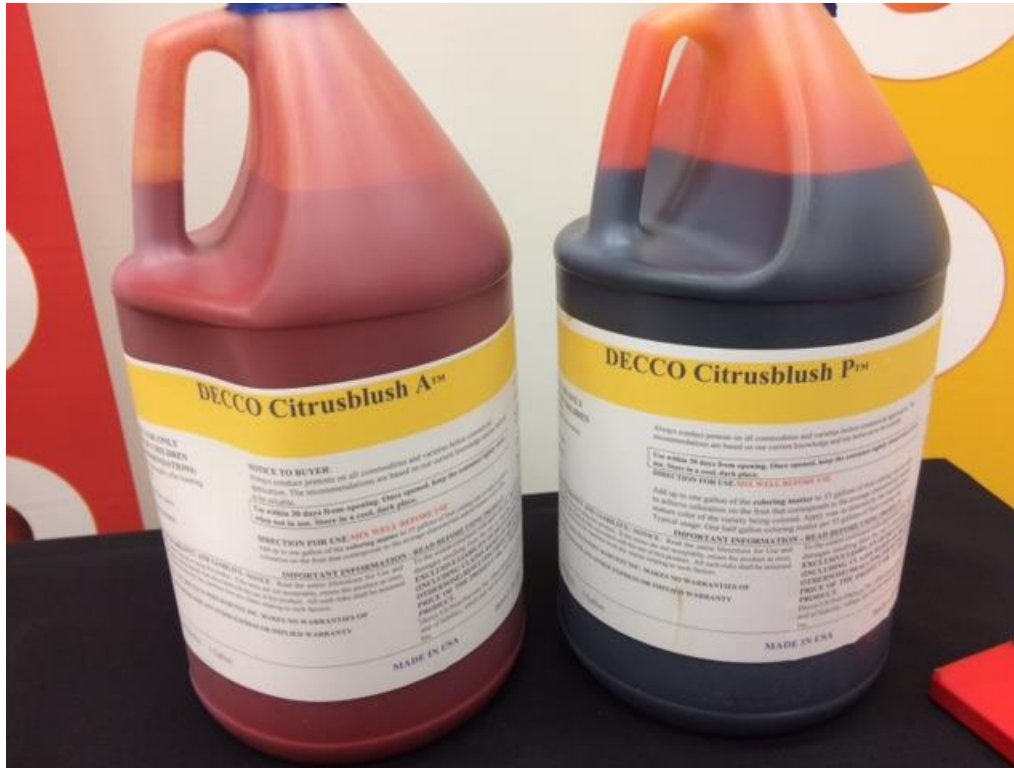




## Comparison between the current two-step CR2 + wax vs. the one-step paprika in wax

Treatment	Day0	Day7 (20 °C)	Day14 (10 °C)
Control (Wax only)			
CR2 then wax			
Paprika in wax			

# Outputs



HORTSCIENCE 50(9):1353–1357. 2015.

## Evaluation of Natural Colorants and Their Application on Citrus Fruit as Alternatives to Citrus Red No. 2

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HORTSCIENCE 52(3):408–412. 2017. doi: 10.21273/HORTSCI11534-16

## Formulating a Natural Colorant Containing Wax for a One-step Color-add Application for Fresh Citrus

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# Current technology and commercial challenges

## ❖ Technology:

- accumulation of colorants/waxes in the valleys of the uneven citrus fruit surface.
- color fading in morpholine free wax.

## ❖ Commercialization:

- DECCO has formulas available.
- Paprika performs better.



# Acknowledgement

## Our team:

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Dr. Mark Ritenour

Dr. Elizabeth Baldwin

Dr. Robert Hagenmaier

Dr. Anne Plotto

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Peter Chairs

Bob Poyner (SunAg)

Kirk Mugler (DECCO)

Food Ingredient Solutions, LLC ; WILD Flavors Inc

Kalsec, Dr. Alvin Chen (JBT), Jimmy Martin (BECO)



## Take home message

- A one-step coloring and waxing technology has been developed, and is available commercially.
- A packinghouse supplier is continually working on improvement of the technology.

