Evaluation of natural colorants and their application on citrus fruit

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Introduction

Do you think we need alternative colorants to Citrus Red No. 2?

❖ Do you think Citrus Red No. 2 is harmful to citrus consumers under current application regulation?
❖ How consumers (or some consumer groups) think about Citrus Red No. 2.

The basic requirements for potential alternatives:

✔ 1) red and orange colors

✔ 2) hydrophobic characteristics so that the color can remain on the fruit surface and not transfer to hands, containers or packaging

Colorants collected based on literatures

❖ Annatto suspension (8% bixin)
❖ Paprika O/S FANS445
❖ β-carotene O/S FANS446
❖ Durabrite® carrot oleoresin
❖ Durabrite® paprika oleoresin

❖ They are all carotenoid compounds
❖ They are all hydrophobic

Therefore, a replacement of CR2 with natural or food grade colorants would benefit the Florida citrus industry.
Results and Discussion

The CIELAB results of CR2 and five natural colorants on test paper dried for 3 hours at 23°C under 300 Lux of standard fluorescent white light.

<table>
<thead>
<tr>
<th>Colorant</th>
<th>L*</th>
<th>a*</th>
<th>b*</th>
<th>a*/b*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR2</td>
<td>76.82 b</td>
<td>31.09 c</td>
<td>10.52 c</td>
<td>2.96 a</td>
</tr>
<tr>
<td>Annatto</td>
<td>54.30 e</td>
<td>45.57 a</td>
<td>39.44 b</td>
<td>1.16 b</td>
</tr>
<tr>
<td>Paprika</td>
<td>67.38 d</td>
<td>36.98 b</td>
<td>56.67 a</td>
<td>0.65 c</td>
</tr>
<tr>
<td>β-Carotene</td>
<td>87.83 a</td>
<td>-1.96 d</td>
<td>53.14 a</td>
<td>-0.04 c</td>
</tr>
<tr>
<td>Carrot oleoresin</td>
<td>88.13 a</td>
<td>-5.89 e</td>
<td>57.35 a</td>
<td>-0.01 c</td>
</tr>
<tr>
<td>Paprika oleoresin</td>
<td>72.76 c</td>
<td>30.08 c</td>
<td>55.61 a</td>
<td>0.54 d</td>
</tr>
</tbody>
</table>

*Mean values followed by different letters within a column indicate significant differences using Duncan test (p < 0.05). CR2: Citrus Red No. 2.

Challenges resolved and remaining

❖ Solubility
- Soluble in pine oil, however, it is extremely difficult to make an application dilution in water.
- Once adding in water, the solution changes to jelly, even rock

❖ Color stability
- Fade of color under
  - Light
  - Warm temperature

❖ Oxidation of carotenoids

Wax protected carotenoids from fading

Changes of color (a*, and a*/b* ratio) values of four colorants on citrus fruit under the storage conditions as 14 days at 41°F (5°C) in the dark, or 8 days at 73°F (23°C). (5(0)-Citrus Red No. 2, 5 C; 5(1)-Annatto, 5 C; 5(2)-Paprika, 5 C; 5(3)-Paprika oleoresin, 5 C; 23(0)-Citrus Red No. 2, 23 C; 23(1)-Annatto, 23 C; 23(2)-Paprika, 23 C; 23(3)-Paprika oleoresin, 23 C).
Progress of our colorant project

- We developed a technology which successfully mixed red/orange color carotenoids to commercial citrus waxes.
- The waxes with colorants can be applied to citrus, to replace the current two-step (coloring then waxing) procedures.
- Further research is required to complete an industry adaptable product/procedure.

Acknowledgement

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Take home message

- An one-step coloring and waxing technology will be available soon.
- Furthermore, the colorants and waxes are natural products.