



September 2025

Reformulation Considerations when Using Natural Colors

Givaudan
Human by nature



Citrus fruits and color language

The light we drink

The eating and drinking experience **involves all the senses.**

But undoubtedly **the visual input modulates and sometimes even overpowers** the other sensory signals.

Colors are omnipresent in the imagery of citruses references and descriptions. Through colors we “see” attributes like:

- **Freshness**
- **Ripeness**
- **Coolness**
- **Sweetness/ Acidity**
- **Tartness**
- **Flavor intensity**
- **Identity**

Sweeter oranges are... Orange!



When participants in a study tasted several colored fruit drinks designed to match an expected flavor identity, they determined that color influenced the flavor intensity for peach, kiwi, orange, and berries flavors.

It also influenced the sweetness perception, but only for the orange flavor!

The authors attributed it to preconceptions and expectations on the sweetness of mature oranges that are typically more intensely colored.



Sweet or Sour?



Prior to tasting a series of orange colored drinks, a beverage panel described expectations based on how the samples looked.

Lighter shades of orange were associated with descriptors like higher sourness/ astringency and flavors like lemon or pineapple.

Darker orange shades were associated with increased sweetness and thickness and flavors of orange, mango, and apricot.



We add colors to drinks

- To restore the visual appearance after processing
- To standardize quality parameters when there are seasonal variations of the raw materials
- To increase the perception of flavor and taste
- To cue for flavor identity



With our current citrus juices and natural citrus oils crisis, we need color more than ever.



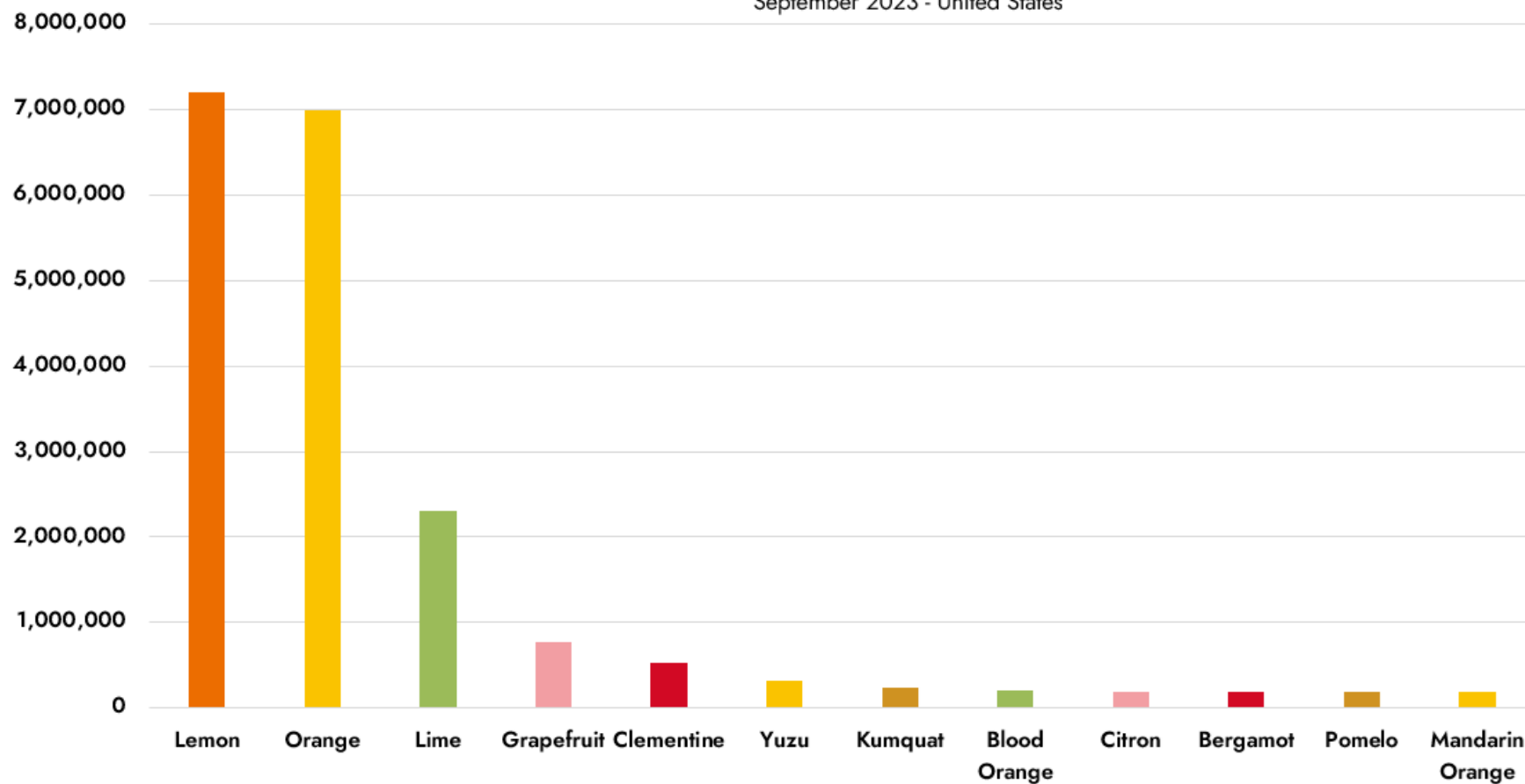
A top-down photograph showing a hand peeling a grapefruit. The hand is on the right, using a small tool to separate a segment of the fruit. The grapefruit is on a light-colored wooden cutting board. Several other segments of the grapefruit are already peeled and arranged on the board. To the right of the board is the large, hollowed-out peel of the grapefruit. The entire scene is set on a green and white striped cloth. The text "Market Insights" is centered over the cutting board in a white serif font.

Market Insights

Consumer Interest

Average Monthly Consumer Searches on Google

September 2023 - United States



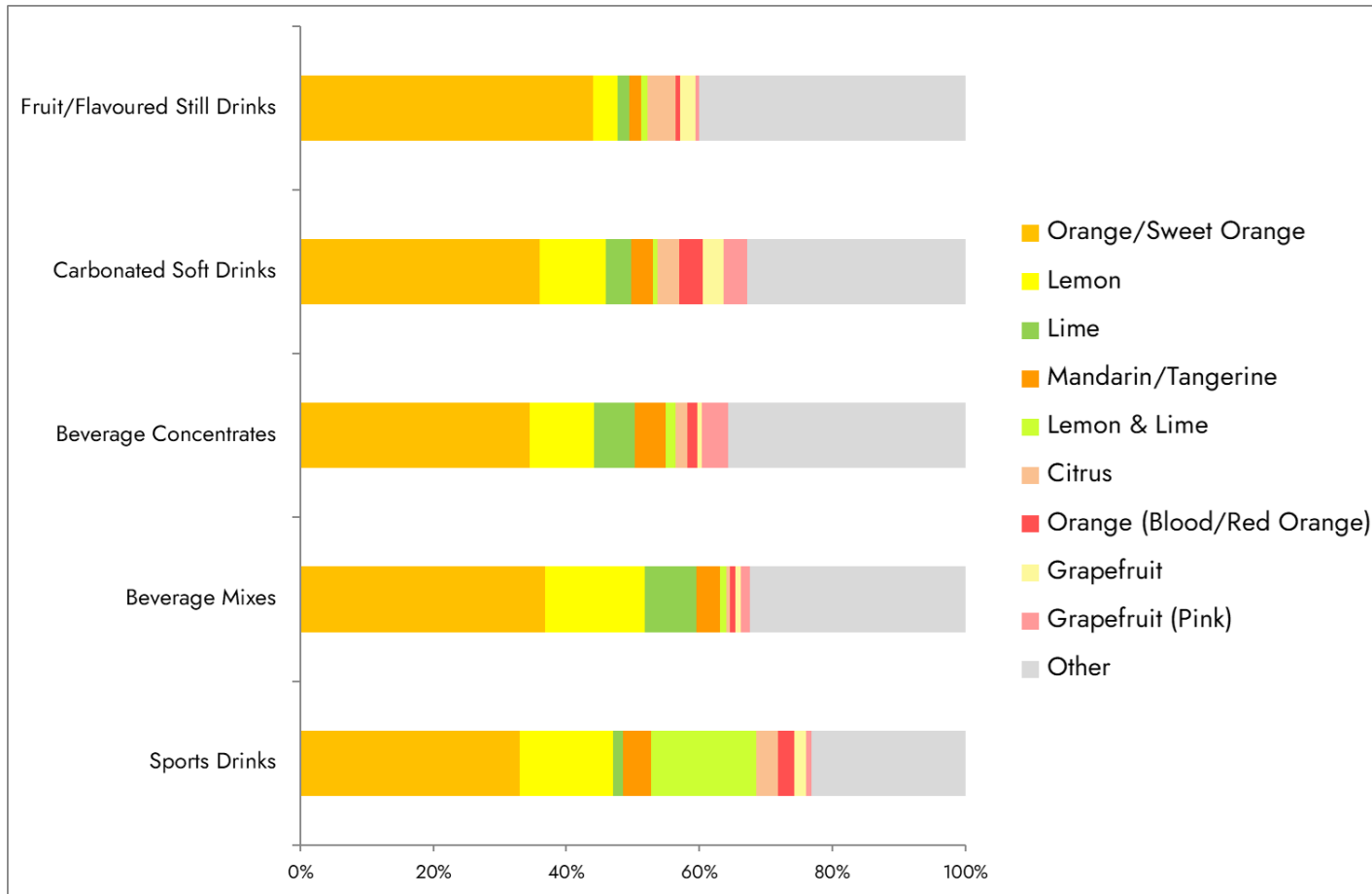
Highest google
search growth
for citrus fruits
goes to...

YUZU

+8.3%
Year over Year

+17.6%
12 Month Forecast

Flavor Split by drink subcategories (2022 -2024)



Source: Mintel GNPD

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Citrus Drinks Trends

- Citrus is a core flavor profile for drinks with drivers like: Tasty, fresh, artisan, gut health, alcohol free
- NPD is growing and diversifying with emerging flavors like orange peel lemon, yuzu, pomelo calamansi, and more.
- Rise in new beverage applications driven by health and wellness trends: blurring beverage categories
- Upcycling models of production are excellent representatives of current sustainability demands

Regional Citrus Flavours Trends

NOAM

- Bold citrus flavors with functional benefits
- Calamansi & yuzu

North America

LATAM

- Lime for tangy profiles
- Mexican escabeche

Latin America

EMEA

- Lemon verbena & botanicals
- Healthier, less-sweet drinks

Eastern Europe

China

South-East Asia

India

Africa & Middle East

APAC

- Sudachi
- Calamansi
- Yuzu

Australia

Source: WGSN

Confidential and proprietary business information of Givaudan

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What can color do for a citrus do for a beverage?



Sudachi

is gaining global traction for its **sour, sweet, and spicy profile**, particularly in **immunity-boosting foods**.



Yuzu

remains a favorite, often replacing lemon in ready-to-eat meals, aligning with the trend of **international flavor fusions**.

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Calamansi

is celebrated for its **sweet-sour and floral notes**, enhancing global cuisine.

A woman with long dark hair and a nose ring is shown in profile, looking upwards and to the right while drinking from a glass of citrus beverage through a straw. The glass contains ice, lemon slices, and a sprig of thyme. The background is dark with some green foliage visible. The text "Replacing Synthetics" is overlaid in a large, white, serif font, and "For Citrus Beverages" is overlaid in a smaller, white, sans-serif font below it.

Replacing Synthetics

For Citrus Beverages



Switching to natural colors

It's all in the approach

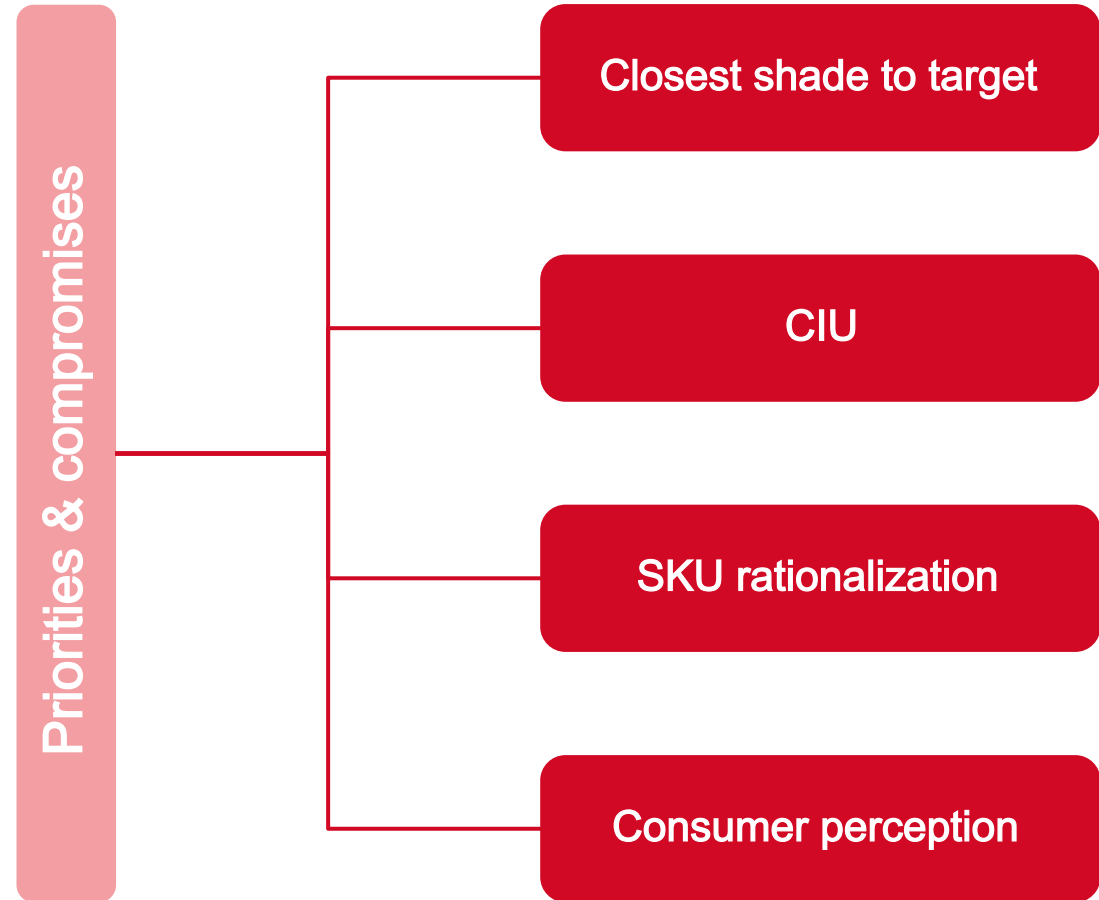
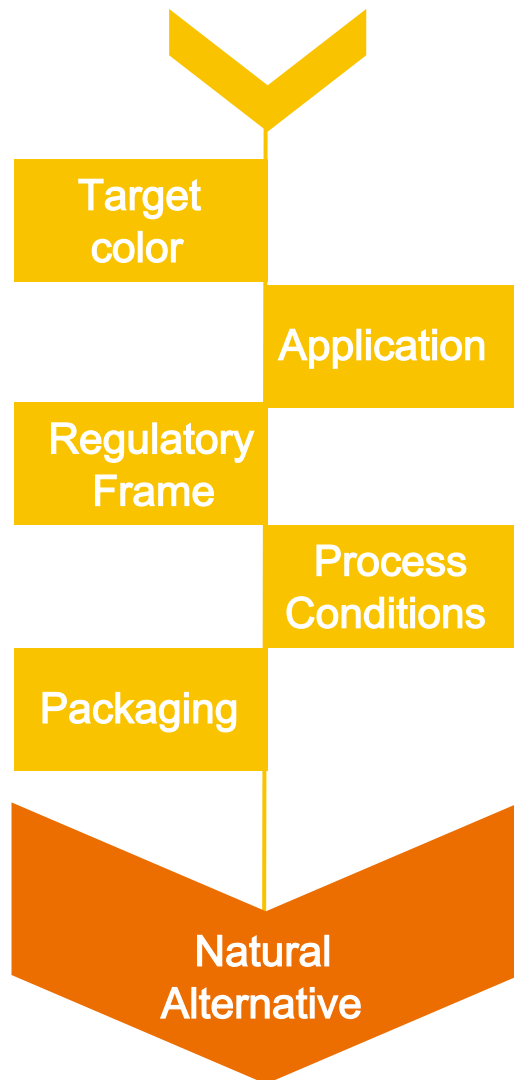
Yes, but...

- Seasonality and variability
- Lack of regulatory harmonization
- Logistics and sourcing struggles
- Difficult to match CIU
- Difficult to achieve same vibrancy
- Difficult to obtain comparable stability

Yes, and...

- Renewable sources
- Biotechnology offers lower footprint
- Improvements in agricultural productivity and pigment yield
- Scale economy
- Your margins and market unit price not substantially affected
- Formulation science has greatly improved stability
- Our technical expertise helps all obstacles during product development

Consider your expectations



When shifting from synthetics....

01

You won't necessarily have 1 : 1 universal replacements

You will have new alternatives: a new coloring pencil case

02

Rates of usage won't necessarily be linearly scalable

Due to effects like color saturation, scattering and dichromatism, you would likely need to reassess usage rates increases

03

Your skus won't necessarily multiply

Sometimes the same natural color can be used to replace two or more formulas that use synthetics
Example: one color at different usage rates can match two synthetic blends

04

Natural Colors are not Plug-and-Play solutions

Changes in formulation and process parameters may require reassessing or even changing the natural color election (e.g. pH packaging, etc)

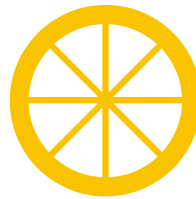
Factors to consider



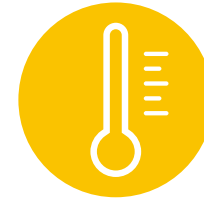
Base
Ingredients



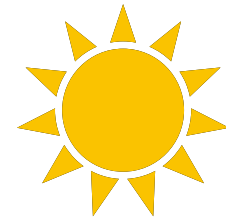
Recipe
(alcohol content,
antioxidants, emulsifiers, etc.)



pH



Thermal
Processing



Light
Exposure



Packaging



Dosage
Rate



Flavor



Regulatory

Influence of the juice content on natural colors

Best color stability was observed at higher juice content

Vegebrite® Orange carrot (3g/L)

Juice content (Orange)



Vegebrite® Golden yellow (2g/L)

Juice content (Tropical)



Base parameters:

pH=3.5 | Brix = 5 °Bx | 100ppm ascorbic acid | No flavor

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Ringing

Carotenoid emulsions



Unstable Emulsion



Stable Emulsions

Carotenoids in presence of Vitamin C



Temperature 40°C



Light

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Temperature 40°C



Light

Anthocyanins in presence of Vitamin C

Ascorbic acid (vitamin C) has a negative impact on anthocyanins stability

Black carrot



0ppm / 25ppm / 50ppm / 100ppm / 150ppm / 200ppm
ascorbic acid (left to right)

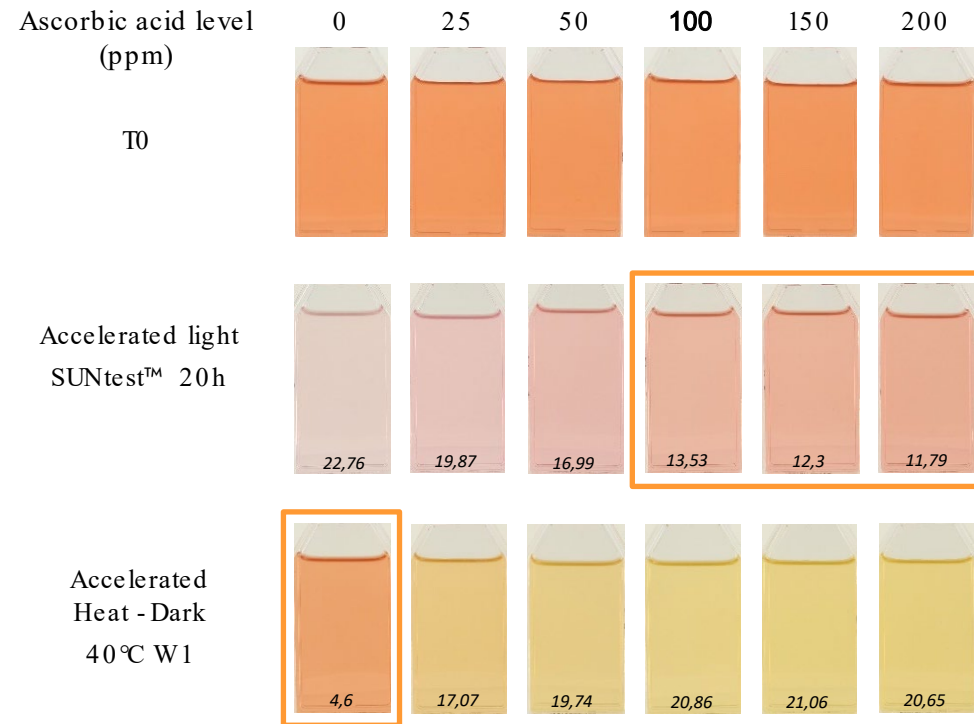
Base parameters:

pH=3.0 | Brix = 5°Bx | After 2 weeks @40°C in dark conditions

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Natural blood orange shade remains a challenge

Vitamin C protects carotenoids but accelerates fading of anthocyanins



Base parameters:

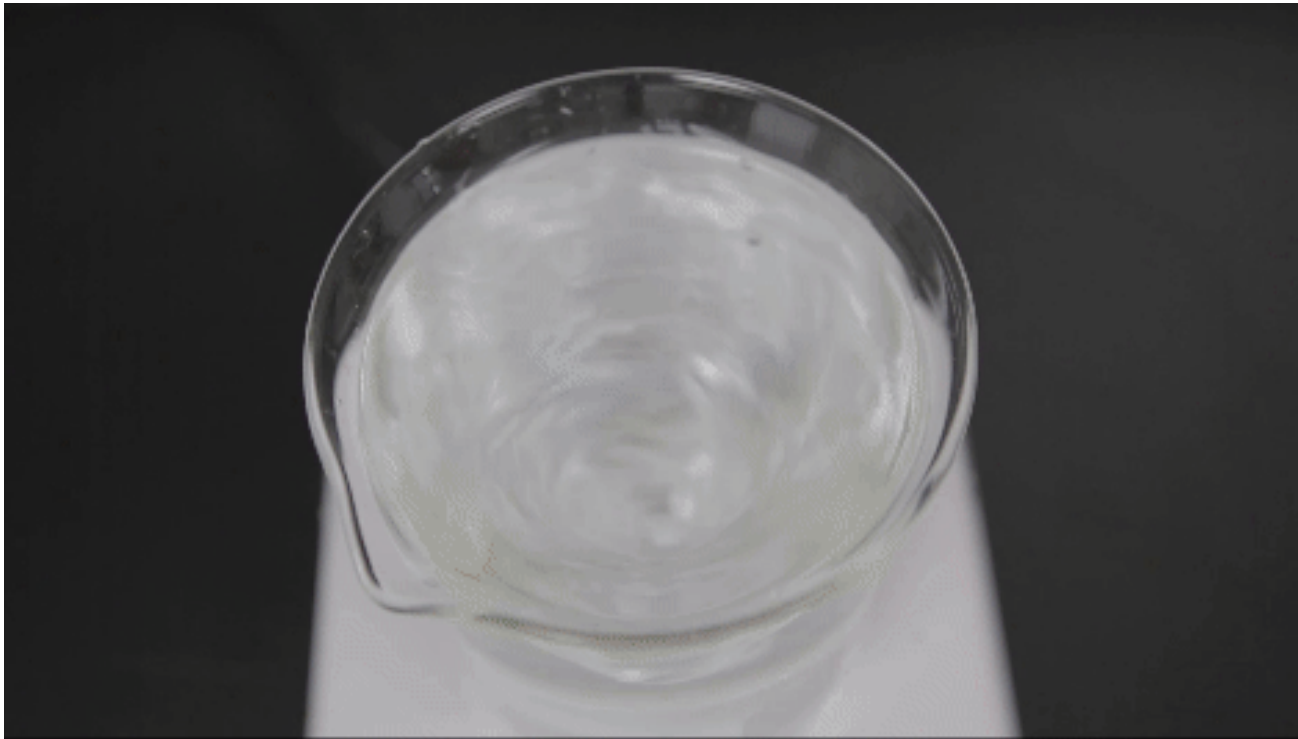
pH=3.3 | Brix = 5 °Bx | 100ppm ascorbic acid | Natural flavor (blood orange)

Black Carrot 0.35 g/L + Betacarotene 0.13 g/L

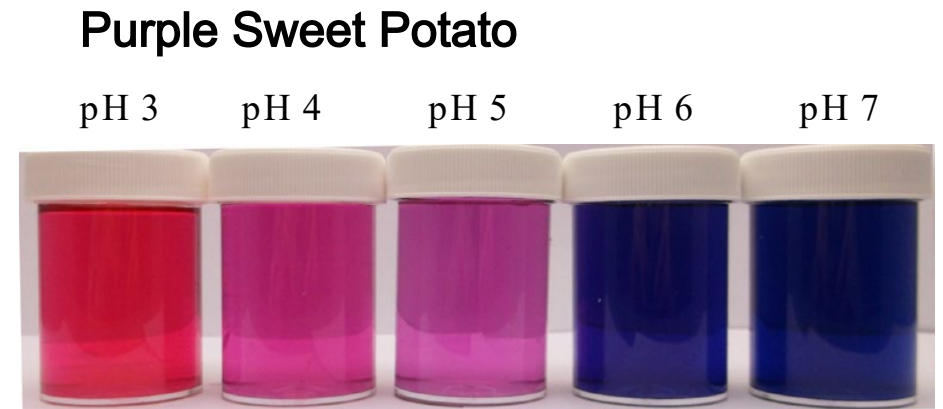
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Anthocyanins change colours!

Anthocyanins exhibit a reversible change in molecular structure, shifting from red/ pink at a low pH to purple/ blue at a higher pH, becoming less stable



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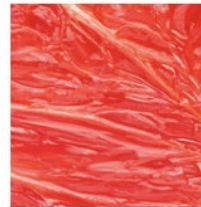
Practical examples

Synthetics replacement



Red

Typical Grapefruit Shades



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Grapefruit

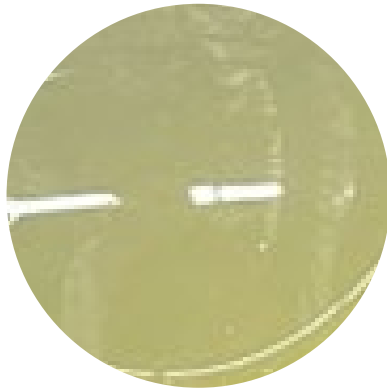
Swatches of Market Examples

**Pomelo Juice
Beverage**



Yellow 5 + Yellow 6
China

**Grapefruit
Juice Drink**



Yellow 5 + Yellow 6
China



emSeal® Beta-
carotene
+
Cranberry Red Blend
+
Cloud

**Pink Grapefruit
Flavored Drink**



Red 40
Poland

**Lemon and Red
Grapefruit Juice**



Red 40
China



Vegebrite® Black Carrot
+
Cloud

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Red 40 Alternatives

Allura Red
0.001%



Red Radish
0.06%



Strawberry Red Blend
0.006%



Amaize®
Orange Red
0.14%



Amaize® Red
0.14%



Vegebrite® Black
Carrot
0.05%



Cranberry
Red Blend
0.08%

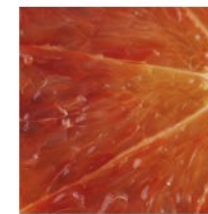


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Orange

Typical Orange Shades



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Orange

Swatches of Market Examples

Orange Drink



Yellow 6 + Yellow 5
+ Ponceau 4R

India



emSeal® Paprika

Orange Drink



Yellow 6 +
Yellow 5

Thailand



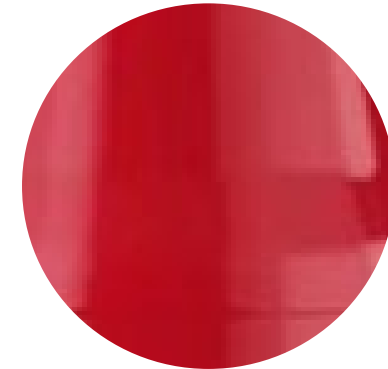
emSeal® beta-
carotene

+

Amaize® Orange
Red

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Blood Orange Drink



Red 40
Germany



Amaize® Orange-
Red

Mandarin, Tangerine, Clementine

Swatches of Market Examples

Mandarin Flavored Drink



Yellow 6 + Red 40

Mexico



emSeal® beta
carotene +

Amaize® Orange
Red

Mandarin Flavored Drink



Yellow 6

El Salvador



Vegebrite®
Orange Carrot

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Yellow 6 Alternatives (Clear)

Sunset
Yellow
0.0013%



emSeal®
Paprika
0.013%



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emSeal® beta-carotene 0.035%
+
Amaize® Orange Red 0.015%



Yellow 6 Alternatives (with cloud)

Sunset Yellow
0.0013%



Vegebrite Orange
Carrot 0.33%



emSeal® Paprika
0.014%



emSeal® beta-carotene 0.03%
+
Amaize® Orange Red 0.003%



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Yellow



Typical Lemon Shades



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Lemon and Lime

Swatches of Market Examples

Lemon Drink



Yellow 5
USA



Turmeric Extract
(for opaque
containers)

Lemon Drink



Yellow 5
Malaysia



emSeal® beta-
carotene

Yellow 5 Alternatives

Yellow 5
0.0013%



Turmeric Extract
0.02%

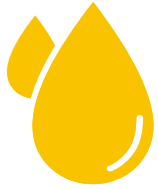


emSeal®
beta-carotene
0.05%



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Summary of Simple Label Solutions



Color emulsions

- Convenient and easy to use
- Bright, warm oranges and yellows
- Optimized formula for drinks
- Minimal color change
- Synergy with citrus juice chemistry



Fruit & Vegetable juice concentrates

- Diverse range: shades of reds and pinks
- Gently processed
- Perfect for low pH drinks
- Excellent functionality and stability
- Negligible flavor impact
- Friendly label



Carrot juice concentrates

- High concentration of rich carotenes
- Bright and warm oranges and yellows
- Gently processed
- Aseptically packaged.
- Easy to use
- Worldwide approved and friendly labeling
- Excellent functionality



Thirsty for more?

Download
our Citrus
Palette!



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