WELCOME TO THE WEBINAR:
The Challenge of Formulating with Natural Colors

Hosted by the PMCA Research Committee
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Let's get started!

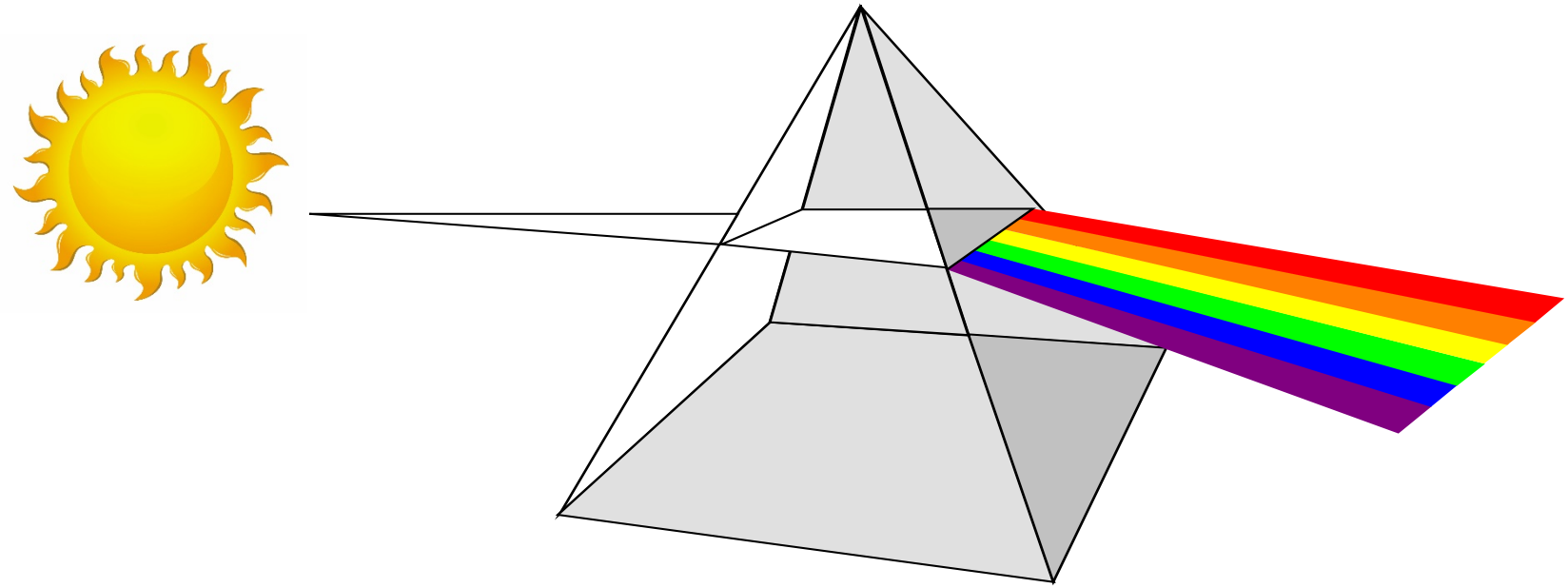
Overview

- **Basics of Food Colors**
- **Applications**
- **Food Color Regulations**

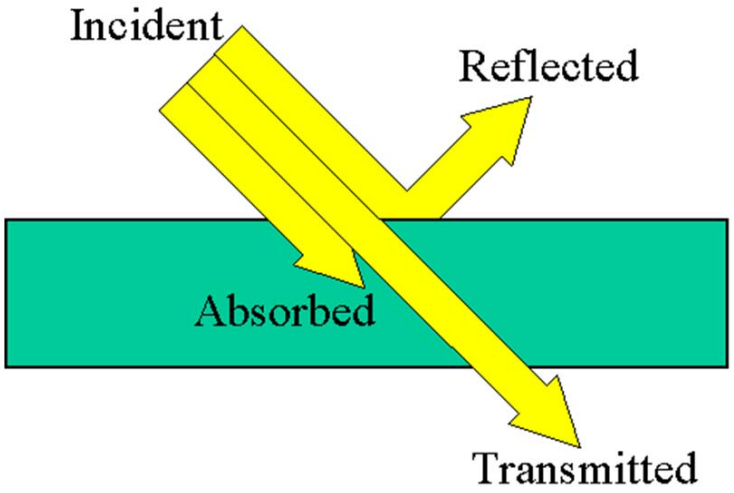
Basics of Food Colors

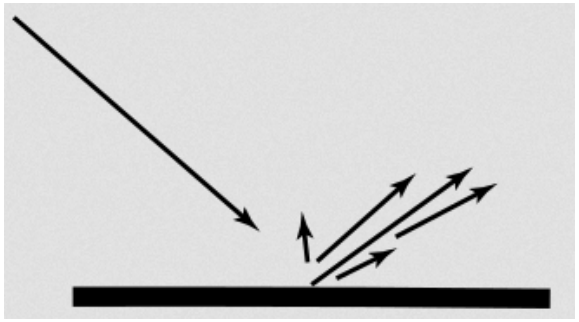
Where Does Color Originate?

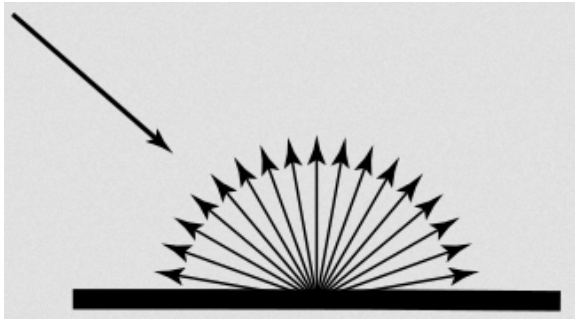
- Light from the Sun appears colorless, sometimes referred to as “white light”.
- White light contains all the colors of the rainbow.
- The wavelengths of light can be separated with a prism.



Basics of Food Colors







Basics of Food Colors

Light Source Affects Color Perception

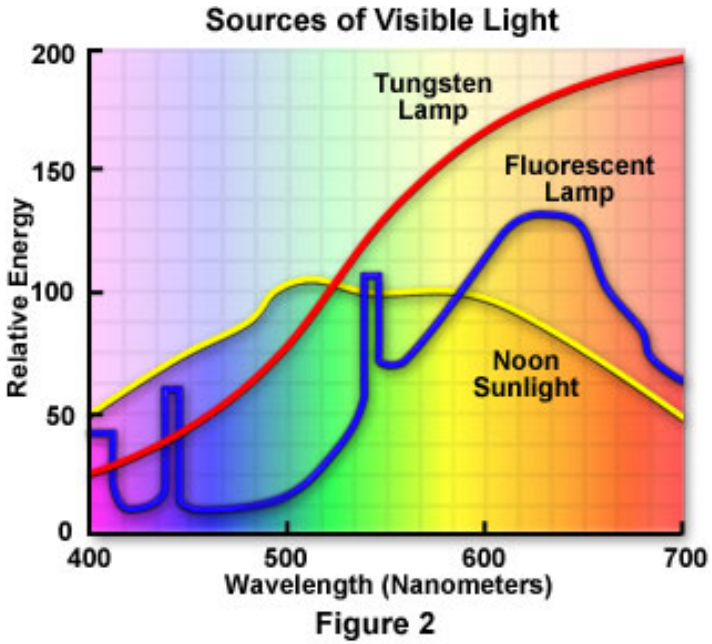
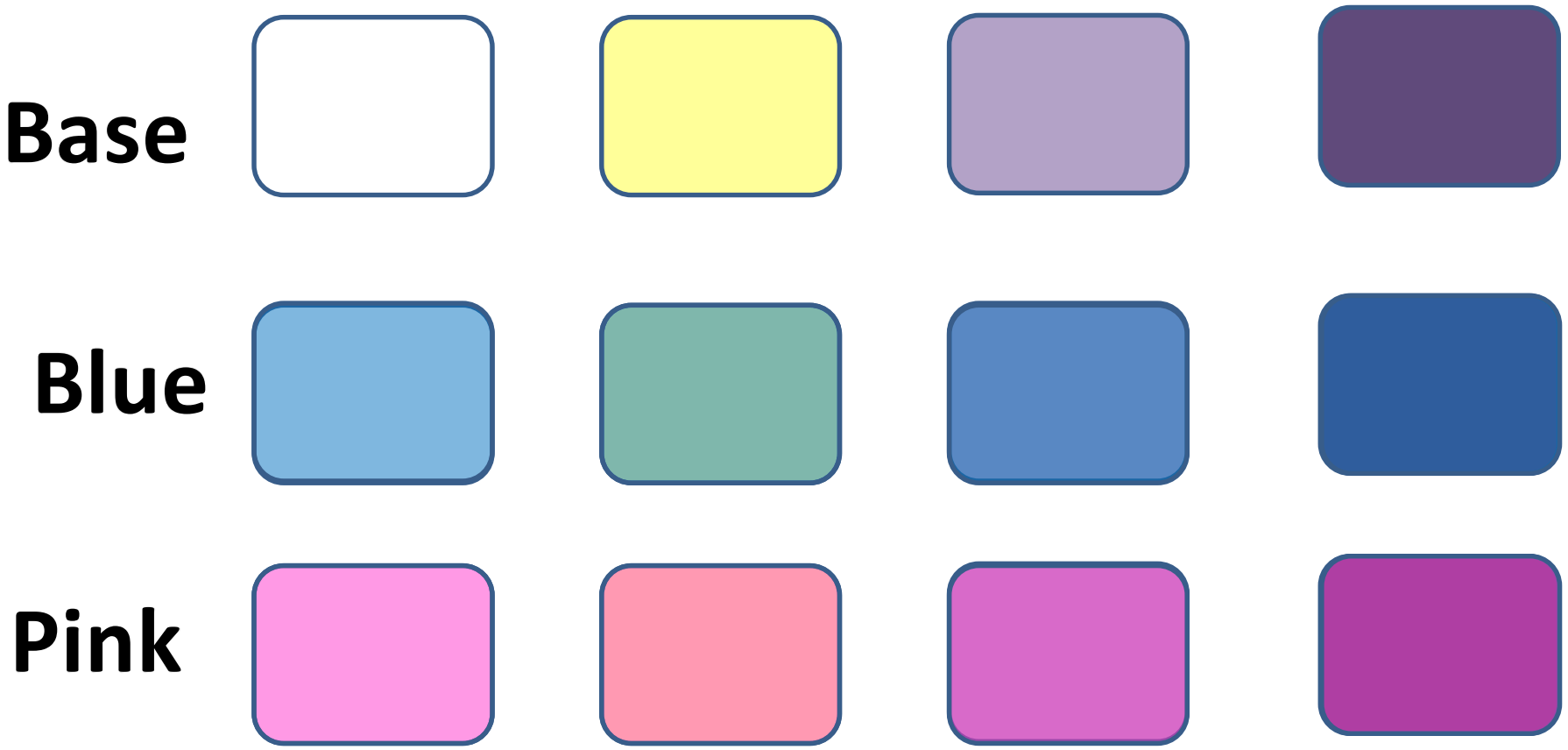


Figure 2

Basics of Food Colors

Color of Your Base Material Affects Final Shade

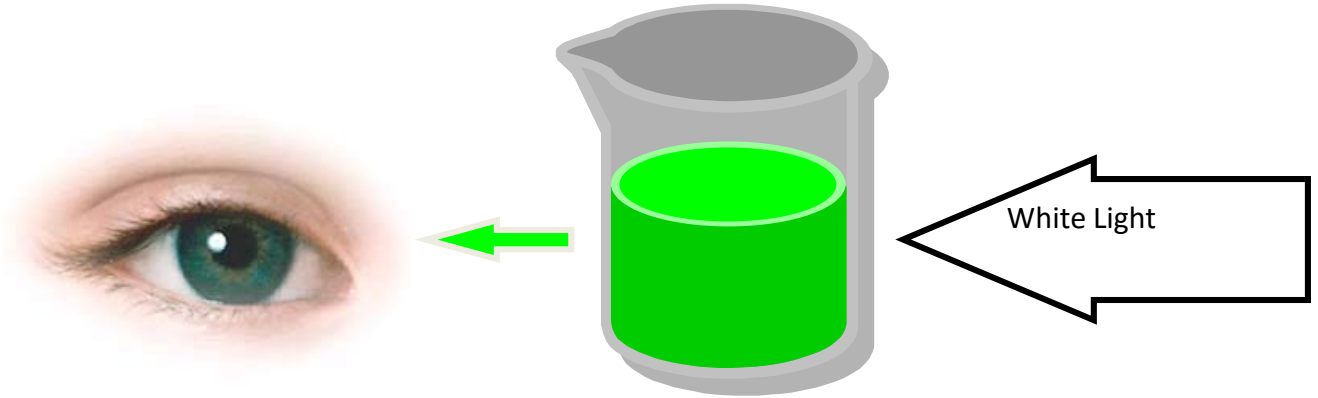


Synthetic Colors

Synthetic Colors

Dyes

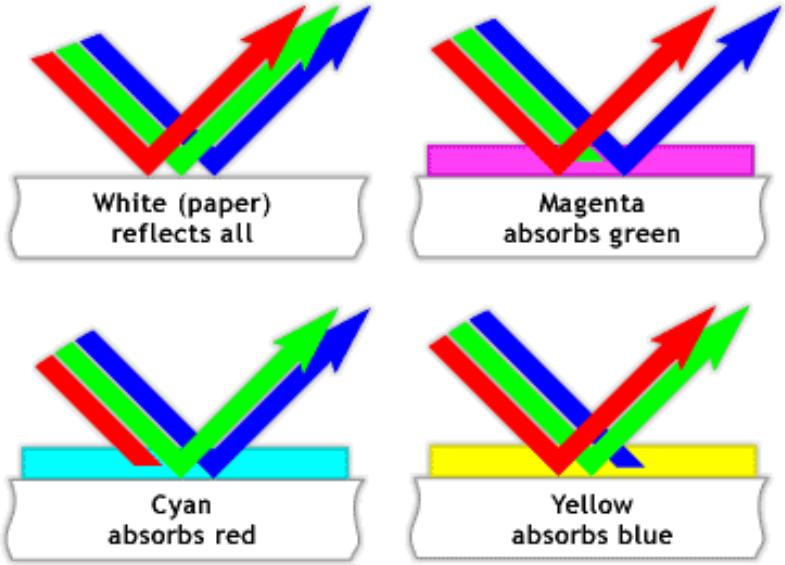
- **Water Soluble**
- **Selectively Absorb Wavelengths of Light**
- **The transmitted light is perceived as color to our eyes**
- **Dyes cause products to appear darker since they limit the amount of light which reaches our eyes**

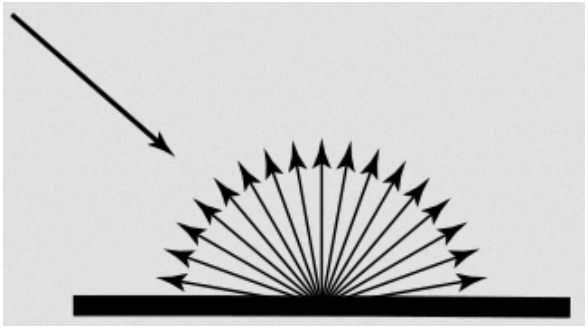


Synthetic Colors

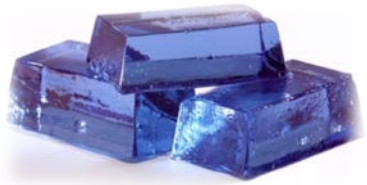
Lakes

- **Lakes are pigments, and are water and oil dispersible**
- **Used in products where color migration or bleed is not desired**
- **Lakes are dispersed throughout the product, not dissolved**
- **The lake pigment absorbs specific wavelengths of light and reflects others**
- **Lakes scatter light, contributing to opacity**





Natural Colorants

Color *(Solubility)*	**Shade**	**Forms**	**Stability**	**Color in Candy**
Turmeric *(Oil Soluble)* *(Water Dispersible)*	Yellow	Powder Dispersion Oleoresin	Heat pH below 6.5 Poor light	
Beta-Carotene *(Oil Soluble)* *(Water Dispersible)*	Yellow Orange	Powder Dispersion	Heat pH Light Poor Oxidation	
Paprika *(Oil Soluble)* *(Water Dispersible)*	Orange Red	Powder Dispersion Oleoresin	Heat Light pH Poor Oxidation	
Annatto *(Bixin - Oil Soluble)* *(Norbixin – Water Soluble)*	Yellow Gold	Powder Dispersion	Light Acid Proof Form Fair Heat Fair Oxidation	
Anthocyanins *(Water Soluble)* *(Can be made into Oil Dispersible)*	Pink Red Purple Blue	Powder Liquid	Heat Light pH changes color	
Carmine *(Oil and water dispersible)*	Pink Red Purple	Powder Dispersion Liquid	Heat pH above 3.5 Light	

Color *(Solubility)*	**Shade**	**Forms**	**Stability**	**Color in Candy**
Beet *(Water Soluble)* *(Can be made into Oil Dispersible)*	Pink Purple Red	Powder Liquid Dispersion	Fair Heat Light Oxidation pH 3.5-5.5	
Spirulina *(Water Soluble)* *(Can be made into Oil Dispersible)*	Blue	Powder Dispersion	Light Oxidation Below 45°C pH 4-7	
Chlorophyll Chlorophyllin *(Chlorophyll - Oil Soluble)* *(Chlorophyllin – Water Soluble)*	Green	Powder Dispersion Oleoresin	Heat Light pH	
Caramel *(Water Soluble)* *(Can be made into Oil Dispersible)*	Brown	Powder Dispersion	Light Acid Proof Form Fair Heat Fair Oxidation	
Oxides *(Oil and water dispersible)*	Red Black Yellow White	Powder Liquid	Heat Light	
Vegetable Carbon *(Oil and water dispersible)*	Black	Powder Dispersion Liquid	Heat pH above 3.5 Light	

Cost Differences

- CIU has declined from new advances in technologies & techniques
- In General
  - Natural colors are more expensive than synthetic colors, but are not cost prohibitive
  - Oxides are less expensive than synthetic colors
  - Nature Identical Colors are less expensive than Nature Derived
  - Color delivery systems (such as dispersions and emulsions) can reduce the cost-in-use of colors
- Examples of Usage Rates
  - Hard Panning
    - FD&C Blue No 1 Lake: 2.0-3.0% in coating syrup
    - Spirulina Power: 1.0-2.0% in coating syrup
  - Gummies
    - FD&C Red No. 40 Dye: 0.025%-0.05%
    - Red Cabbage (anthocyanin): 0.15-0.30%

Supply Chain

- Nature Derived colors are harvested from farms
- Most of the larger color companies have vast supply chains which can supply colors large enough for the biggest of brands
- Be sure to speak with your color vendor about their natural color volume capabilities

Hard Panning

Natural Color Selection	Delivery Methods
• Water Soluble or Water Dispersible • Moderate to Great Heat Stability • Coating Syrup pH	• Sugar Based • Aqueous Dispersions • Liquid Colors • Powders • Rice matrix pigments

Reds	Oranges	Yellows	Greens
o Carmine o Iron Oxide o Anthocycanins	o β-Carotene o Paprika	o Turmeric o Riboflavin o β-Carotene	o Mixture of Blues & Yellows

Blues	Violets	Blacks	Whites
o Anthocyanins o Spirulina	o Anthocyanins o Mixtures of Blues and Reds o Carmine	o Vegetable Carbon o Iron Oxide o Caramel	o Titanium Dioxide o Opacifying Agents

Hard Panning

Common Concerns/Issues

- Poor Sealing and Drying
- Temperature/pH/hold time of Syrup
- Brix of Syrup
- Achieving an opaque base layer
- Rework or additional layers

Possible Controls/Solutions

- Ensure center is sealed well
- Ensure grossing shell is opaque/smooth
- Use heat stable colors for high brix applications
- Minimize inversion in syrup for proper drying (for sucrose)
- Control drying air…. Flow rate, time applied, humidity

Over-Drying

pH too low

°Bx too low

Too Fast Rotation

Color variation – dye vs lake

Hard Candy

Natural Color Selection	Delivery Methods
• Water Soluble or Dispersible Colors • Great Heat Stability • pH Stability • Acids/Flavors Used	• Liquid Colors • Propylene Glycol • Glycerin

Reds	Oranges	Yellows	Greens
o Lycopene o Iron Oxide o Anthocycanins	o β-Carotene o Paprika o Canthaxanthin	o Turmeric o Riboflavin o β-Carotene	o Mixture of Blues & Yellows

Blues	Violets	Blacks	Whites
o Anthocyanins	o Anthocyanins o Mixtures of Blues and Reds	o Vegetable Carbon o Iron Oxide o Caramel	o Titanium Dioxide o Opacifying Agents

Hard Candy

Common Concerns/Issues

- Heat
- Added moisture
- Light stability
- Acids/Flavors Used
- Flavor Off Notes

Possible Controls/Solutions

- Use flavors/acids which do not adversely affect color
- Add heat sensitive colors after cooking
- Protect product from light exposure if less light stable colors are required for desired shade

Too Much Moisture

Beet added at 100°C and 145°C

Flavor variations

Gummies/Gels

Natural Color Selection	Delivery Methods
• Water Soluble or Water Dispersible Colors • Moderate or Greater Heat Stability • pH compatible with flavoring systems	• Glycerin • Propylene Glycol • Liquid Colors • Powders

Reds	Oranges	Yellows	Greens
o Carmine o Iron Oxide o Anthocycanins	o β-Carotene o Paprika o Canthaxanthin	o Turmeric o Riboflavin o β-Carotene	o Mixture of Blues & Yellows

Blues	Violets	Blacks	Whites
o Anthocyanins o Spirulina	o Anthocyanins o Mixtures of Blues and Reds	o Vegetable Carbon o Iron Oxide o Caramel	o Titanium Dioxide

Gummies/Gels

Common Concerns/Issues

- Heat
- Flavor Off Notes
- Light stability
- pH (especially when specific one is needed for proper set)
- Vitamin/neutraceuticals

Possible Controls/Solutions

- Speak with color vendor about all vitamins/nutraceuticals used
- Add heat sensitive colors after gelatin is solubilized
- Use opaque packaging for light sensitive colors and protection for WIP
- Consider alternate gel agent (LM pectin versus HM for blue/purple shades)

Vitamin C Attacking Anthocyanins Overtime

Light Stability of Turmeric Over 24 hours

Compound Coatings/ Fat Based Fillings

Natural Color Selection	Delivery Methods
• Oil soluble or oil dispersible colors • Emulsions • Moderate Heat Stability	• Oil • WO emulsion • Powders • Rice matrix pigments

Reds	Oranges	Yellows	Greens
o Iron Oxide o Anthocycanins o Carmine	o β-Carotene o Paprika o Annatto	o Turmeric o Riboflavin o β-Carotene	o Mixture of Blues & Yellows

Blues	Violets	Blacks	Whites
o Anthocyanins o Spirulina	o Anthocyanins o Mixtures of Blues and Reds o Carmine	o Vegetable Carbon o Iron Oxide o Caramel	o Titanium Dioxide

Compound Coatings/Fat Based Fillings

Common Concerns/Issues

- Heat
- Flavor Off Notes
- pH
- Acids/Flavors Used
- Light stability

Possible Controls/Solutions

- Use opaque packaging for light sensitive colors
- Introduce heat sensitive colors while product is cooling
- Use suitable oils/emulsifiers for emulsions and dispersions

Too Much Heat Applied

Poor Emulsion Used

Compressed Tablets

Natural Color Selection	Delivery Methods
•Plating-grade colors •Moderate to great heat stability •Interaction with flavoring system •Light stable colorants dependent on packaging	• Powders • Rice matrix pigments

Reds	Oranges	Yellows	Greens
o Carmine o Anthocycanins	o β-Carotene o Paprika o Annatto	o Turmeric o Riboflavin o β-Carotene	o Mixture of Blues & Yellows

Blues	Violets	Blacks	Whites
o Anthocyanins o Spirulina	o Anthocyanins o Mixtures of Blues and Reds o Carmine	o Vegetable Carbon o Caramel	o N/A

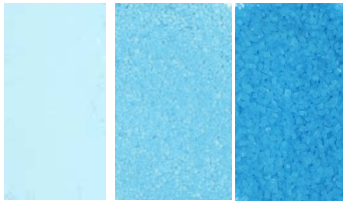
Compressed Tablets

Common Concerns/Issues

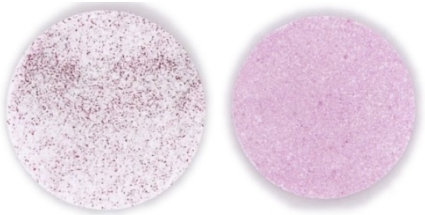
- Pressure used in compression
- Acids/Flavors Used
- Flavor Off Notes
- Light Stability
- Base particle size

Possible Controls/Solutions

- Use opaque packaging for light sensitive colors
- Use flavors/acids which do not adversely affect color
- Change base particle size to minimize color usage



Strength Increases With Increasing Particles Size



Non-Plating Grade Vs Plating Grade Beet

Marshmallows

Natural Color Selection	Delivery Methods
• Water Soluble or Water Dispersible Colors • Oxidative Stability	• Liquid Colors (not oil based)

Reds	Oranges	Yellows	Greens
o Carmine o Iron Oxide o Anthocyanins	o β-Carotene o Paprika o Canthaxanthin	o Turmeric o Riboflavin o β-Carotene	o Mixture of Blues & Yellows

Blues	Violets	Blacks	Whites
o Anthocyanins o Spirulina	o Anthocyanins o Mixtures of Blues and Reds	o Vegetable Carbon o Iron Oxide o Caramel	o N/A

Marshmallow

Common Concerns/Issues

- Flavor Off Notes
- Light and oxidative stability
- Heat stability
- De-aeration due to the surfactant nature of some carriers, oil soluble colors
- Inability to get dark color
- Base color influence

Possible Controls/Solutions

- Control density to assure consistent color
- Add heat sensitive colors toward end of process
- Use opaque packaging for light sensitive colors and protection for WIP
- Choose pastel colors

Sugar/ corn syrup

Dried Cane/ tapioca syrup

Dried Cane/ brown rice syrup

PMCA Webinar

May 31, 2016

Regulation of “natural” colors

- Color additives exempt from certification – “natural colors”
  - Some are readily recognizable as foods or derived from natural food sources such as vegetables
    - Ex. paprika, turmeric, tomato lycopene, grape skin extract, fruit and vegetable juices
  - Some have animal sources
    - Ex. cochineal/carmine
  - Others are mineral in origin
    - Ex. titanium dioxide
  - Or synthesized/processed
    - Ex. caramel, canthaxanthin
- Specifications and requirements in 21 CFR Part 73

US FDA Labeling of Foods Containing Colors

- No provision in the FDA regulations for the designation of color additives as “natural”
  - Color additives are “certified colors” or “color additives exempt from certification”
- Exempt from Certification Colors must be declared
  - Either as “artificial color,” “artificial color added,” or “color added”
  - Or, as “colored with _____” or “_____” color”
- Are there any circumstances in which a food may be labeled as “naturally colored” or “colored naturally” or something similar?
  - Yes, if the color additive was from the food it is coloring

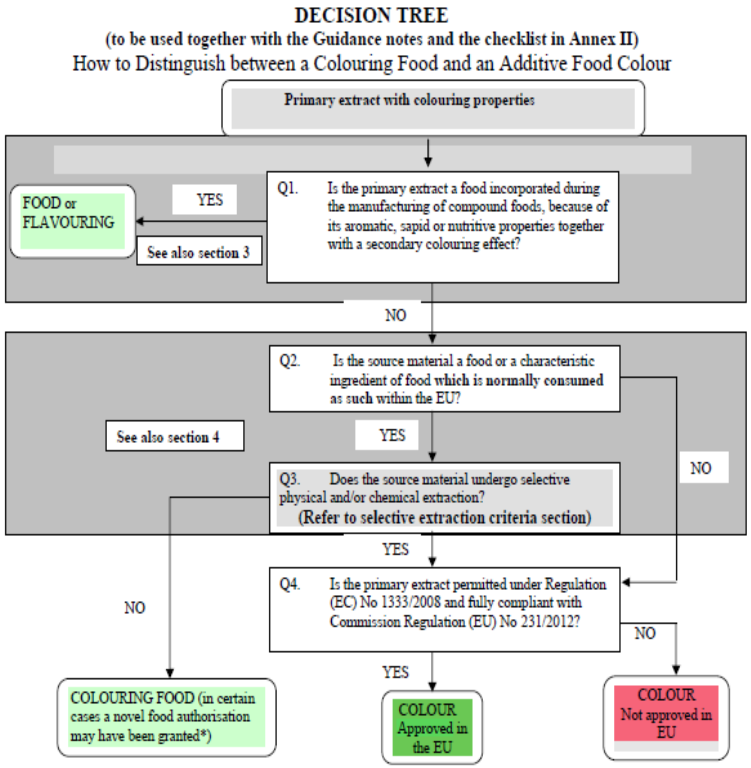
US FDA Labeling of Foods Containing Colors

- Carmine/cochineal
  - Specific declaration required – 21 CFR 73.100(d)(2)
  - Allergenic in small proportion of the population
- Paprika, turmeric, saffron, other spices that may be used as colors– "spice and coloring." 21 CFR 101.22(b)(2)
- Fruit juice (21 CFR 73.250) and vegetable juice (21 CFR 73.260)
  - Attractive for clean label purposes.
  - Key issue is that these must be juices, not pigments isolated from juices.
  - FDA has issued regulatory correspondence on this topic collected by IACM for member use

European Labeling

- In Europe, all food additives are given labeling codes commonly referred to as “E-numbers”
  - Colors are traditionally labeled not by name but by E-number
- Colors are considered Food Additives
  - Substances which add or restore color in a food, and include natural constituents of foods and natural sources which are normally **not consumed as foods as such and not normally used as characteristic ingredients of food**.
  - Preparations obtained from foods and other edible natural source materials obtained by physical and/or chemical extraction resulting in a **selective extraction** of the pigments relative to the nutritive or aromatic constituents are colors within the meaning of this Regulation
    - Selective Extraction is not defined in EU legislation but Commission developed **Guidance notes on the classification of food extracts with coloring properties**
- Colors are not:
  - foods, whether dried or in concentrated form, includingflavorings incorporated during the manufacturing of compound foods, because of their aromatic, sapid (taste) or nutritive properties together with a **secondary coloring effect**

EU Coloring Foods



Canadian Regulations

- Colors are regulated by the Canadian Food and Drug Act, Division 6
  - B.06.01 Natural Colors (contains specifications and listed by pigment)
  - Table III (Division 16) Food Additives that may be used as coloring agents
- Basic Labeling Requirements are included in Annex 2-2 Class Names for Ingredients[B.01.010(3)(b)]
  - When one or more of the colors listed in Table 3 of Division 16 are used label as “Color”
  - Labels must be bilingual (English and French)
- Canada has proposed amendments that would require that manufacturers list all food colors by their common name within the list of ingredients on the food label

Codex GSFA

- There are currently 46 colors with draft and/or adopted provisions in the GSFA
  - 8 colors have a JECFA ADI of "not specified" and are listed in Table 3 of the GSFA
    - Examples include Beet red, 3 Lycopenes and Titanium dioxide
  - 38 colors have a numerical ADI and are only listed in Tables 1 and 2 of the GSFA
- Total of 1,895 draft and adopted provisions for colors in the GSFA
  - Represent ~ 1/3 of all provisions in the GSFA
  - 990 adopted provisions and 905 draft provisions
- New additives must be assigned an INS number by CCFA and undergo a JECFA review before being considered for GSFA
  - IACM has requested new INS numbers for: spirulina extract, red radish color, purple sweet potato color, carthamus yellow, black carrot extract and JECFA review of spirulina extract
- Note 161 Challenges
  - "Subject to national legislation of the importing country aimed, in particular, at consistency with Section 3.2 of the Preamble"
  - There are 125 provisions for colors in the GSFA associated with Note 161 (~30% of all provisions associated with Note 161)

International Regulations

- Most countries treat colors as a food additive and do not regulate “natural” colors differently than synthetic
  - Trend toward following Codex and/or EU model for regulating food colors
  - Issue with following Codex model (GSFA) is lack of colors and/or provisions that have been finalized due to ongoing issue of Note 161

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Thank you for joining the PMCA colors webinar

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