Making the Move from Synthetic to Natural Colors

Finding suitable natural-color replacements for synthetic colors can be a challenging process in which many different factors must be taken into consideration.

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Growing consumer preference for natural colors (particularly among millennials), and for using ingredients from recognizable sources, has fueled the recent growth in the use of natural colorants. In fact, many of the largest confectionery companies in the world are now promising the removal of artificial colors and flavors from their North American brands within the next five years.

For many, converting from synthetic to nonartificial colors can be difficult due to the differences in stability, flavor off-notes, cost and achievable shades. This is especially true for confectioners who have never before used natural colors. This paper will discuss commonly seen difficulties confectioners have over an array of confectionery applications when switching from synthetic to natural colors.

To begin this topic on how to convert from synthetic to nonartificial colors, let's discuss the basics of colors.

BASICS OF FOOD COLORS

We see examples of colors being used throughout ancient history. Their use in food probably spread from the use of colors in cosmetics. We see examples of colors being used in cosmetics before 2000 BC in Egypt, and paintings in Egyptian tombs depict the coloring of candy as early as 1500 BC. More definitive evidence comes from Roman historians detailing how to artificially color wine to make it appear darker and redder as early as 300 BC. Skipping closer to the Middle Ages, we have books written discussing the use of specific herbs and fruits to artificially color medicines and drinks. It would not be until the 19th century, though, when synthetic colorants (mauvine being the first) were created, and towards the end of that century before they would be used in confections.

But, why should we use colors? Colors are used for a variety of reasons in foods, primarily for aesthetic reasons, to denote flavor or texture qualities, or to give an impression of the overall quality of the food. Many candies would be clear and colorless without the incorporation of color additives and would probably be unappealing to the consumer without them. In fact, numerous studies have been performed showing a con- ➤

nection between perceived taste and color with additional findings suggesting that color is responsible for up to two-thirds of the consumer's decision for purchasing a product. It's easy to see, then, why color is so important.

One such study involved yellow cake. A group of participants were given slices of yellow cake where the flavoring remained constant or decreased with increasing color concentration. As the participants ate their pieces of cake, it was found that with increasing color, the more intense was their perception of flavor in the piece of cake. Some participants even reported that a piece of unflavored yellow cake had too much lemon flavoring.

In grade school we learned how Sir Isaac Newton shined light through a glass prism and saw the colors of the rainbow: red, orange, yellow, green, blue, indigo and violet. Later, physicists discovered that light actually contains a much broader spectrum of wavelengths than what is shown in the visible spectrum. The roughly 400 nm-to-700 nm bandwidth that the human eye can see is perceived by two different types of photoreceptive cells: cones and rods. Typically, humans have three distinctive sorts of cone cells to perceive color; these cells take in wavelengths of light in the green, red or blue spectrum. The combination of the wavelengths of light which these cells absorb eventually becomes what we perceive as color.

Light can interact with objects in a variety of different ways, such as reflection, absorption and dispersion (scattering). Most colored objects either selectively reflect or absorb specific wavelengths of light back to the eyes. The source of light can greatly affect the color of food, too. For example, the sun emits a spectrum of visible light that is vastly different than artificial light from normal tungsten or fluorescent lights. The color of a food product will change under different light sources, therefore it is important to know where and how a product will be displayed.

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Artificial Colorants

In the United States, the artificial colorants allowed for use in food are called *certified colors,* which are compounds of known structure, produced by chemical synthesis and conforming to high purity specifications established by the FDA. There are two forms of food colorants: dyes and pigments. Food dyes are soluble in water and manifest their colors by being dissolved. The actual mechanism of coloring is called *light absorption*, whereby dyes, once dissolved, selectively absorb specific wavelengths of light, and transmit other wavelengths. The transmitted light is perceived as color. There are nine certified dyes allowed for food-coloring applications in the United States, seven of which can be used in confections: FD&C Blue No. 1, Blue No. 2, Green No. 3, Yellow No. 5, Yellow No. 6, Red No. 3 and Red No. 40. Outside of the United States, there are many more synthetic colors allowed, including Quinoline Yellow, Patent Blue, Green S, Brown HR, Brilliant Black, carmoisine, Ponceau 4R and amaranth.

These synthetic colorants have a known chemical composition and relatively well-known stabilities. For example, FD&C Yellow No. 5 precipitates out of solutions at cold temperatures; FD&C Yellow No. 6 will form an insoluble calcium salt if not protected; FD&C Blue No. 2 and Brilliant Black are relatively unstable in water and when exposed to light; FD&C Red No. 3 works best in pH systems above 4; and Green S and Patent Blue will change colors at lower pH ranges.

The other form of artificial colorants used in foods is lakes. Lakes are pigments, and as such are insoluble. Lakes manifest their colors by reflecting light. With lakes, light is not

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only reflected, but also scattered. Thus it is important that the color is evenly dispersed throughout the food matrix so that the greatest amount of surface area of the pigments is exposed to light and reflected. Lakes can be used in any application where they can be suitably and uniformly dispersed to impart their color. These colorants should be used in products where color migration or bleed is not desired.

Commonly Used Natural Colorants

In the United States, natural colorants allowed for use in food are called *exempt-from-certification colors*. They are obtained from vegetable, animal and mineral sources, or are synthetic duplicates of naturally existing colorants.

Let's briefly go over the more commonly used natural colorants, and their key characteristics.

Turmeric (also known as **curcumin**) is a spice commonly used in central and eastern Asian cuisines. It is a yellow pigment that has poor light stability, excellent heat stability and is pH stable below 6.5.

The **carotenoids** are a class of colorants ranging in shades from yellow to red, including **beta-carotene** and **paprika**. The nature-identical (synthetically derived) form of beta-carotene is more commonly used. Paprika is an orange-to-red color extracted from peppers. Carotenoids, in general, are heat, pH and light stable, but are susceptible to oxidation.

Annatto is a yellowish-gold color extracted from the oil coating found on seeds in the pods of achiote trees. The oil-soluble form is known as **bixin**, which can be converted into a water-soluble form known as **norbixin**. Both bixin and norbixin are light stable, and have fair heat and pH stability. Only acid-stable forms of norbixin should be used in acidic environments.

Anthocyanins, a subclass of flavonoids, are water-soluble colors derived mainly from fruit and vegetable sources. These have fair heat and light stability and are stable in liquid form at a pH below 3.5. Anthocyanins have a unique ability to change colors depending upon the pH of the environment in which they are placed. With increasing pH, anthocyanins change color from yellow to pink, then red, then purple, then blue, then green and back to yellow. However, anthocyanins are most stable in the pink and red ranges in liquid form.

Carmine is a bright pink color, and is derived from the cochineal insect found in Central and South America. Dye is extracted from the insect and dried, resulting in cochineal extract. This extract is then precipitated onto an aluminum-based substrate to form a water-insoluble pigment. Carmine is heat and light stable, and is stable in a pH above 3.5.

Beet is a water-soluble red colorant with poor heat stability. It works best with a pH range of 3.5 to 5.5. Beet can provide vibrant red, pink and purple shades, especially in sugar-panning applications.

Spirulina is a blue color that was recently approved for use in confections in the United States. Spirulina is not allowed as a food colorant in Europe, but is allowed as a coloring foodstuff. This is discussed further below. Spirulina is a water-soluble color that has fair heat stability and prefers a pH range of 4.0 to 7.0.

Chlorophyll and **chlorophyllin** are not allowed for use in confections in the United States, but they are allowed in much of the rest of the world. Chlorophyll is oil soluble and not very heat or light stable. Chlorophyllin, the porphyrin backbone of chlorophyll, is water soluble and much more stable than chlorophyll, but it is more susceptible to oxidation.

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Caramel is a water-soluble brown colorant created from the heat treatment of carbohydrates (such as corn) and is heat, light and pH stable. There are four classes of caramel in the United States: Class 1 (those not manufactured using sulfites or ammonia); 2 (with sulfites); 3 (with ammonia); and 4 (with both sulfites and ammonia). Classes 1 and 2 do not require special package labeling on products sold in California.

Oxides include **iron oxides** and **titanium dioxide**. These are relatively inert and very stable pigments. Iron oxide can be found in shades of red, yellow and black; titanium dioxide is bright white in color.

Vegetable carbon, also known as **carbon black**, is a natural black colorant made from the burning of vegetables. Vegetable carbon is not permitted in foods in the United States. Some countries in the Asia-Pacific region require that vegetable carbon be produced from specific plants.

There are several other natural colorants. Of special mention are **carthamus** (not permitted in the USA), a bright yellow color more light stable than turmeric, and **lycopene**, a red carotenoid color with great heat stability.

Colors can be mixed into a confectionery matrix through a variety of carrier (color delivery) methods, such as powders, liquid colors, dispersions or emulsions. The type of carrier used depends upon the intended application and the suitability of the carrier for the desired colorants. *Powders* are blends of dry colorants, sometimes with added stabilizers. Colors dissolved in water, oil or another medium are referred to as *liquid colors*. *Dispersions* are liquid systems where pigments are dispersed and suspended in a food-grade carrier. For confections, these carriers are typically water, syrup, glycerin, propylene glycol, wax or oil. *Emulsions* are a mixture of two or more immiscible liquids. Emulsions are a unique type of dispersion, where one of the liquids is dispersed in another. Typically, emulsions are employed when the desired colorant will not normally incorporate well into the target application. For example, a water-soluble anthocyanin color (such as elderberry juice) could be dissolved in water, after which the colored water could be dispersed in oil. This fruit juice-colored emulsion could then be used to color compound coating.

FOOD COLOR REGULATIONS

The early history of food color regulations is not as extensively studied, but nonetheless interesting. One of the first modern food regulations was written in the 16th century in what is now Germany, whereby those found guilty of selling fake saffron (an orange-red spice often used to color drinks) would be punished with the loss of their left hand. In the late 19th and early 20th centuries we see an explosion in the use of color additives in food, coinciding with the discovery and development of synthetic colorants. The increased use of colorants grew to be of concern to governmental bodies because colorants known to be poisonous were sometimes used in foods; more often, those foods of poorer quality were colored to deceive the consumer. For example, at the end of the 19th century in England, milk-delivery companies would often color milk with yellow dye to make it indistinguishable from the older inventory of milk. It became such a common practice that housewives began to reject white whole milk under the belief that the fresh milk was adulterated. The United States first legalized the use of color additives in food (butter) in 1886. Modern U.S. food color regulations progressed over time to our current laws based on legislation originally written in 1960.

The safety of foods containing synthetic

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Making the Move from Synthetic to Natural Colors

Natural Colors

Color	Shade	Forms	Stability	Color in Candy
Turmeric	*Yellow*	Powder Dispersion Oleoresin	Heat pH below 6.5 Poor light	
Beta-Carotene	Yellow Orange	Powder Dispersion	Heat pH Light Poor Oxidation	
Paprika	*Orange* *Red*	Powder Dispersion Oleoresin	Heat Light pH Poor Oxidation	
Annatto	*Yellow* *Gold*	Powder Dispersion	Light Acid Proof Form Fair Heat Fair Oxidation	
Anthocyanins	*Pink* *Red* *Purple* *Blue*	Powder Liquid	Heat Light pH changes color	
Carmine	*Pink* *Red* *Purple*	Powder Dispersion Liquid	Heat pH above 3.5 Light	
Beet	Pink Purple Red	Powder Liquid Dispersion	Fair Heat Light Oxidation pH 3.5-5.5	
Spirulina	Blue	Powder Dispersion	Light Oxidation Below 45°C pH 4-7	
Chlorophyll Chlorophyllin	Green	Powder Dispersion Oleoresin	Heat Light pH	
Caramel	Brown	Powder Dispersion	Light Acid Proof Form Fair Heat Fair Oxidation	
Oxides	Red Black Yellow White	Powder Liquid	Heat Light	
Vegetable Carbon	Black	Powder Dispersion Liquid	Heat pH above 3.5 Light	

Southampton Six Synthetic Colors

Color	Tartrazine	Quinoline Yellow	Sunset Yellow	Ponceau 4R	Allura Red	Carmoisine
FD&C Name	Yellow No. 5		Yellow No. 6		Red No. 40	
E-Number	E-102	E-104	E-110	E-124	E-129	E-122
Countries Permitted	Canada, China, EU, Mexico, USA	China, EU, Mexico	Canada, China, EU, Mexico, USA	China, EU, Mexico	Canada, China, EU, Mexico, USA	China, EU, Mexico
						

Other Common Synthetic Colors

Color	Erythrosine	Brown HT	Brilliant Blue	Brilliant Black	Indigo Carmine	Green S
FD&C Name	Red No. 3		Blue No. 1		Blue No. 2	
E-Number	E-127	E-155	E-133	E-151	E-132	E-142
Countries Permitted	Canada, China, EU, Mexico, USA	EU, Mexico	Canada, China, EU, Mexico, USA	China, EU, Mexico	Canada, China, EU, Mexico, USA	EU, Mexico
						

Hard Panning

Natural Color Selection	Common Concerns	Possible Solutions	Delivery Methods
• Water Soluble or Water Dispersible • Moderate to Great Heat Stability • Coating Syrup pH	•Poor Sealing and Drying •Temperature and pH of Syrup •Brix of Syrup •Opaque Grossing Shell	• Ensure chocolate center is sealed well • Ensure grossing shell is opaque • Use heat stable colors for high brix applications	• Sugar Based • Aqueous Dispersions • Liquid Colors • Powders


Over-drying


pH too low


°Bx too low


Too fast rotation

Hard Candy

Natural Color Selection	Common Concerns	Possible Solutions	Delivery Methods
•Water Soluble or Dispersible Colors •Great Heat Stability •pH Stability •Acids/Flavors Used	•Heat •Added moisture •Light stability •Acids/Flavors Used •Flavor Off Notes	• Use flavors/acids which do not adversely affect color • Add heat sensitive colors after cooking	• Propylene Glycol • Glycerin


Too much water


Beet added at 100°C and 145°C


Flavor variations affecting shade

Gummies

Natural Color Selection	Common Concerns	Possible Solutions	Delivery Methods
•Water Soluble or Water Dispersible Colors •Moderate or Greater Heat Stability •pH compatible with flavoring systems	•Heat •Flavor Off Notes •Light stability •pH and neutraceuticals	• Speak with color vendor about all vitamins/nutraceuticals used • Add heat sensitive colors after gelatin is solubilized • Use opaque packaging for light sensitive colors	• Glycerin • Propylene Glycol • Liquid Colors • Powders


Vitamin C Attacking Anthocyanins Overtime


Light Stability of Turmeric Over 24 hours

Compound Coating

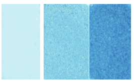
Natural Color Selection	Common Concerns	Possible Solutions	Delivery Methods
•Oil soluble or oil dispersible colors •Emulsions •Moderate Heat Stability	•Heat •Flavor Off Notes •pH •Acids/Flavors Used •Light stability	• Use opaque packaging for light sensitive colors • Introduce heat sensitive colors while product is cooling • Use suitable oils/emulsifiers for emulsions and dispersions	• Oil • WO emulsion • Powders


Too much heat applied


Poor emulsion used

Compressed Tablets

Natural Color Selection	Common Concerns	Possible Solutions	Delivery Methods
•Plating-grade colors •Moderate to great heat stability •Interaction with flavoring system •Light stable colorants dependent on packaging	•Pressure Used in compression •Acids/Flavors Used •Flavor Off Notes •Light Stability •Base particle size	• Use opaque packaging for light sensitive colors • Use flavors/acids which do not adversely affect color • Change base particle size to minimize color usage	• Powders


Strength increases with increasing particle size


Non-plating grade versus plating grade beet

colors has been debated over the past 40 years. Although some of the studies promoted by interest groups are of questionable science, and the Food and Drug Administration (FDA) has stated that the nine synthetic colors allowed for use in foods are safe for consumption, a large population of consumers is looking for alternative foods colored from recognizable sources. The most commonly cited concern is in regard to perceived hyperactivity in children and the consumption of azo-dyes. In the 1970s, pediatrician Dr. Benjamin Feingold claimed that aspirin, artificial flavors and artificial colors were some of the causes for hyperactivity in children. Because of his books, several studies were performed by the FDA, National Institutes of Health and a few universities over the next three decades, which provided little to no correlation to diets containing synthetic colors and observed hyperactivity. Nevertheless, the publication of a study performed at the University of Southampton in 2007 was the cause of much media attention in Europe and eventually led to a warning label being added to all foods sold in Europe containing one of the "Southampton Six" dyes: Allura Red, carmoisine, Ponceau 4R, Quinoline Yellow, Sunset Yellow and tartrazine. Because the practices in the 2007 study were questionable and the results have never been reproduced, Europe did not see a need to ban the colorants in food. The FDA concluded in three separate reports, most recently in 2011, that "a causal relationship between exposure to color and hyperactivity in children in the general population has not been established."

Although the FDA has stated that the nine synthetic colors allowed for use in foods are safe for consumption, a large population of consumers is looking for alternative foods colored from recognizable sources.

In the United States, the Food and Drug Administration defines a color additive as any dye, pigment or other substance made or obtained from a fruit, vegetable, mineral, animal or other source capable of coloring a food, drug or cosmetic product, or capable of coloring any part of the human body. Color additives are not regulated as food additives, nor are they, as a rule, on the generally recognized as safe (GRAS) list. The FDA further classifies food colors into two separate categories: certified colors and exempt-from-certification colors.

Certified Colors

As discussed earlier, those colors classified as certified colors are synthetically manufactured and are the commonly known FD&C colors: FD&C Red No. 40, FD&C Blue No. 1 Lake, etc., with a total of seven dyes and six different lakes that are allowed for use in candy. The FDA requires that each of these must conform to high purity specifications—which leads to the reason why they are named *certified colors*: after testing for purity, the FDA certifies each batch made by every color vendor. Once certified by the FDA, the batch is assigned a unique FDA lot number and can officially be labeled as FD&C Red No. 40, etc.

Exempt-from-Certification Colors

Colors classified as exempt from certification are what most of the food industry would term as "natural." These colors are obtained from fruit, vegetable, mineral or animal sources, or are synthetic duplicates of naturally existing colorants. Just like the certified colors, the exempt-from-certification colors must meet high purity specifications established by the FDA, but unlike certified colors, the FDA does not confirm or certify these batches. This is often referred to as *self-certification* in the color industry. In total, the FDA lists 36 different exempt-from-certification colorants allowed for use in various foods, of which 23 may be used in confections.

Regulations of natural colors are a bit more complicated than synthetics. In the

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United States, the synthetic colorants allowed for use in candy can be utilized at limits which meet good manufacturing practices. This limit allows for very vibrantly colored candies. For natural colorants, each class has its own usage limit, and some have application restrictions, too. For example, titanium dioxide may only be used up to 1.0 percent by weight of the finished food product; spirulina may be used in candy and chewing gum, but not in extruded cereals. One final note about color regulations in the United States: if it could be a color, then it is a color. The FDA views anything that could be deemed as a color—even if it is not intended to function as a color—as a color and it would fall under FDA's color regulations. For example, spinach extract (where chlorophyll or stabilized chlorophyllin is the chromophore) is allowed as a colorant in Europe, but currently is not allowed in gummies in the United States.

EU Regulations

Outside of the United States, regulations can sometimes be confusing. For example, in Europe there are separate food-colorant and coloring-foodstuff regulations. The EU began writing its current legislation on foods in the 1960s, and has amended it every half-decade or so since. Towards the end of the previous century, the EU began requiring certain food products to be listed along with a corresponding E-number. Color additives (E-numbers) are labeled with their name and respective E-number, and these all have their respective usage rates depending upon the finished application. With consumers becoming more aware of the ingredients in their foods, the idea of an E-number became associated with "chemical" or "non-natural," even though many natural ingredients had their own E-numbers. In reaction to this, consumer groups in Europe began lobbying for an additional labeling category called *coloring foods*. Coloring foodstuffs were defined as food extracts not requiring E-number labeling and which provide an additional function other than color (such as a flavoring component). For those foodstuffs labeled as coloring foodstuffs, the color concentration cannot be more than six times of that found in nature.

Understanding these regulations can be tricky for companies, especially when first working with natural colors. When questions arise, formulators should speak with their color vendor to determine if their products are suitable for use and within the applicable color regulations.

MAKING THE MOVE TO NATURAL

Making the move from synthetic to natural can sometimes be difficult. Users not accustomed to natural colors sometimes assume both natural and synthetic colors should behave the same. However, this is not the case. The differences in heat, light, oxidative and pH stability among the natural color spectrum are much greater than the synthetic spectrum. Having an understanding of the stability and capabilities of the color being used will help in the natural-color conversion process.

Users not accustomed to natural colors sometimes assume both natural and synthetic colors should behave the same. However, this is not the case.

Two topics often brought up by those first beginning the process to convert to natural colors are costs and supply chain concerns. It used to be that all naturals cost more than synthetics. Thanks to advancements and improvements in technologies and techniques, this is not always the case. Some natural colors have a higher cost in use than synthetics, but generally are not cost prohibitive. In general, the oxides (iron oxide and titanium dioxide) are the least expensive option, and are usually less expensive than synthetic options; nature-identical colors are less expensive than nature-derived ➤

variations; and color-delivery systems (such as dispersions and emulsions) can reduce the cost in use of colors.

Nature-derived natural colorants are, as their name states, derived from nature. This means that the raw materials used to make these colors must be planted and harvested prior to color extraction. Because of this, it is necessary to provide accurate volume forecasting with your color vendor.

In 1997, *Food Formulating* magazine asked food developers what their most troublesome formulating ingredients were, and colors were ranked second. The following sections will discuss commonly seen difficulties confectioners have in this conversion process when making hard-panned candy, compound coating, hard candy, gummies and compressed tablets.

Panned Candies

Coloring in the hard-panning process involves covering dragées with a series of colored coats of sugar syrup. A dragée is a sugarcoated nut or candy piece. Prior to applying color coats, though, the chocolate piece is sealed, and then grossing steps are applied. Typically, a white colorant or opacifying agent is added in some of the grossing steps to create a uniform white dragée. After this, color coats are applied prior to finishing and polishing. The three most common mistakes seen in initial natural-color conversions for panned candies are a poor sealing of the chocolate, using nonpurified water for the coating syrup and not having a uniform white coat prior to color applications. Other things to consider for this process are the pH of the syrup, the temperature in which the syrup is held, the solubility of the color and flavor off-notes. Color can be added to the coating syrup by mixing in powders, liquid colors or dispersions. To ensure effective use of powder colors, the powder must be fully dissolved or dispersed in the coating syrup prior to application. Typically, sugar syrup or aqueous-based dispersions are used for their ease of use, and because they require less storage space and less postproduction cleanup.

A large percentage of natural colors are affected by pH, most notably anthocyanin-based colors commonly found in fruits and vegetables. The pH of the syrup must be high enough to prevent inversion of the sugar, while also keeping the pH in the desired color range of the anthocyanin. To ensure the proper pH, use purified water and if necessary, a buffering system.

Additionally, high temperatures can affect some natural colors. This is especially true when hard panning with high-Brix syrup or soft panning. Natural colors such as turmeric, carotenoids or iron oxides can be utilized in high-heat applications, whereas some beet and annatto colors should be used with caution.

The solubility of the color should be taken into account. When hard panning with a pigment, such as iron oxide, color migration between the individual dried coats of syrup should not occur. However, when using water-soluble colors such as spirulina or caramel, one must make certain that each coat is evenly dried prior to adding the next color coat. When insufficient drying is employed, the water-soluble colorants can migrate through the sugar shell, causing splotching or mottling on the finished dragée.

When insufficient drying is employed, the water-soluble colorants can migrate through the sugar shell, causing splotching or mottling on the finished dragée.

The light stability of the color should be considered when packaging panned candies in nonopaque packages. For example, colors such as riboflavin, annatto and beta-carotene can be used instead of turmeric for a yellow color, since they offer improved light stability.

The impacts that natural color may have on the flavor of the finished product should

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also be considered. Although some natural colors such as the carotenoids have great heat, light and pH stability, they can also bring along unwanted flavor notes. This can be mitigated by using deodorization or flavor-masking technologies.

Compound Coating

Coloring white compound coating typically involves heating the fat matrix until it becomes a liquid, then mixing in the color. Considerations involved when choosing colors for compound coating should include the light and heat stability of the color, the solubility of the color and flavor off-notes. Although the temperature of compound coating rarely reaches the temperatures to which colors are exposed in the high-friction environment of a hard-panning application, only colors that are moderately or more heat stable should be selected. Oil-based dispersions, emulsions and powder colors are the most commonly employed color-delivery methods.

Colors that are fat soluble or fat dispersible should be chosen. Colors that are water soluble should be placed into an emulsion system, or changed to a fat-dispersible form prior to being added to a compound-coating matrix.

Hard Candies

For hard candies (boiled candies), it is best to add the color after the candy has been cooked and is cooling down. When formulating a product, heat, light and flavorings used should be considered. With hard candies, only colors that are heat stable should be employed. Of concern are some flavoring systems commonly used in hard candies containing ascorbic acid (vitamin C). Ascorbic acid will attack most anthocyanins in acidic solutions, causing a condensation polymerization—effectively destroying the color. Because of this, carefully consider which flavors and acids are to be used when working with anthocyanin-based colors.

Typically, propylene glycol- or glycerin-based dispersions are used to incorporate the color into the boiled-candy matrix. Besides being easier to mix in than powders, using these dispersions also lowers the necessary cook time needed, compared to using liquid colors.

Gummies

For gummies, color is mixed into the gummi base either after the base mixture is produced or as a component in the nongelatin mixture prior to mixing in the dissolved gelatin. After mixing, the colored mixture is poured into moulds for cooling. In both methods, light and heat stability, solubility of the color, pH stability and flavor off-notes should be taken into account. Just as in hard candies, the flavors or vitamins used should be taken into consideration.

Liquid colors, powders and glycerin-based dispersions are typically used for gummi applications. When using heavy pigment dispersions (such as iron oxides or titanium dioxide) in gummies, it is important to ensure that there is enough mixing in your tank prior to depositing to prevent the settling of pigment. Otherwise color variation within the same batch will be observed.

Compressed Tablets

Compressed tablets involve the dry mixing of colorants prior to tableting. When formulating a compressed tablet, heat and light stability, plating characteristics, pH and flavor off-notes should be considered. The color must evenly coat the dry base in a process known as *plating*; this occurs when smaller particles are dispersed in a matrix of larger particles, thereby exposing a larger-sum surface area than the larger particles. Increasing the usage of the plating ➤

Oil-based dispersions, emulsions and powder colors are the most commonly employed color-delivery methods for compound coating.

Often overlooked are the acids and flavors used in a compressed tablet. The acid components can affect the color of the finished tablet.

color or increasing the particle size of the dry base will intensify the color of the candy. The compression in the tableting process exposes the natural colorants to a brief moment of intense heat; because of this, moderately to more heat-stable colors should be utilized. Dry-powder colors are used to mix into the tablet base.

Often overlooked are the acids and flavors used in a compressed tablet. The acid components can affect the color of the finished tablet. Although by definition there must be water in order to have a pH, there is residual water in almost every foodstuff. Over time, acids can slowly attack and change the color of a mint, especially if a pH-sensitive colorant is used.

CONCLUSION

When making the move to natural colors, one must ask the following questions: Does this color meet the applicable regulation? Will other ingredients affect the color? Is the color suitable for the manufacturing process? Is the color suitable for the packaging?

Finding suitable natural-color replacements for synthetics is a challenging process in which many different factors must be taken into consideration. However, having an understanding of how color works in confectionery applications will make the switch easier.

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