

## Going Natural

7 considerations when converting to natural-sourced colors



# Leading global food manufacturers are converting to natural colors. This guide provides knowledge on how to streamline the conversion process.

Campbell, General Mills, Hershey, Kellogg, Kraft and Mondelez... what do these global food manufacturers have in common besides owning some of the most beloved brands of multiple generations? They are reformulating products to be colored by Mother Nature. The movement to switch from artificial ingredients to those considered natural extends beyond the packaged goods sector. Foodservice favorites such as Pizza Hut and Taco Bell are now following the lead of Chipotle and Panera with plans to reformulate their menus to exclude artificial colors.

This movement has spread from specialty retailers like Aldi and Trader Joe's who are building their in-store brand identity around perceived safe and natural colored food products to large mainstream retailers such as Kroger. All naturally colored private label brands, such as Simple Truth, has grown at a double-digit rate in the last three years since its launch. It is expected to post annual sales of \$1.5 billion in 2015.

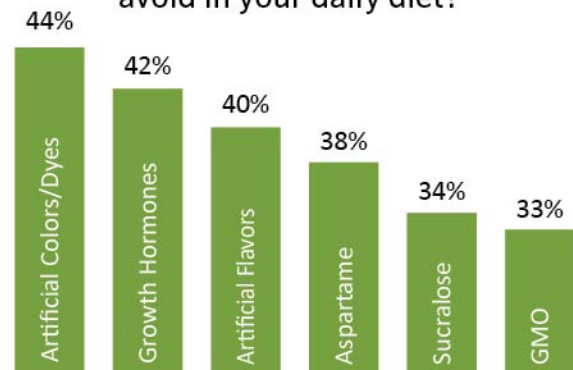
Consumer research indicates the R&D investment to convert from artificial colors to those sourced from nature will have long-term benefits in building brand equity and attracting new users. In May 2015, Fortune magazine published a special report entitled "The War on Big Food." In it, industry executives identify the foundational shift in consumer desires that is fueling the actions of food giants.

**“There is a connection in consumers' minds between overall health, wellness and knowing exactly what I'm eating,” said Hershey's head of global R&D Will Papa. “Consumers want treats, and they want to know that the treat is really good and wholesome.”**

In May 2014, Chr. Hansen, Natural Colors Division, Milwaukee, conducted a proprietary consumer study with U.S. moms to understand what they look for in food labels and to gauge their perceptions of natural ingredients. The survey showed that 83% of the 1,140 respondents wished there were more naturally derived food offerings from food companies. Moms are demanding shoppers.

The trend extends to other consumer demographics as well. Research from The Hartman Group, Bellevue, Wash., reveals that Millennials believe the choices they make reflect their values, rewarding those brands with an honest philosophy and a transparent brand. More than half (52%) of Millennials actively seek out foods and beverages made with natural ingredients. This is even higher than prior generations like Gen X (51%) and Baby Boomers (45%).

## “What are you deliberately trying to avoid in your daily diet?”



Source: The Hartman Group, A Culture of Wellness 2013 (n=2,551 U.S. adults) \* selected ingredients

With consumers' heightened expectations of their favorite brands to be free of artificial colors, it is time to make the conversion to colors sourced from nature. Formulating right the first time is critical to safeguarding the brand, ensuring regulatory compliance and keeping—even growing—your consumer base.

With more than 140 years of unique application knowledge and global expertise, Chr. Hansen identified seven of the most important considerations when reformulating your product with natural colors. In this guide we have shared these insights. We hope you find it useful and look forward to a conversation around your specific journey!

*Mary Bentley*

Chr. Hansen  
Senior Vice President  
Natural Colors, North America





# Compliance:

## Considering the Do's and Don'ts of Regulatory

Before you begin the conversion from synthetic to natural colors, it is critical to do your due diligence. Considerations include raw material assessment, food safety evaluation, type of food application, which end-market/s will the product be sold and consumed in, and last how do you label the color and what can be claimed. Often a food product is designed to serve multiple markets and comply with dietary constraints like GMO-free or Kosher, such goals should be considered upfront to ensure that your color choice is consistent. As natural sourced colors are "hot" with consumers, front-of-pack claim is another consideration. Would you want to claim "colored with fruits and vegetables," or is simply "contains no artificial colors" acceptable? Chr. Hansen's global network of in-house regulatory experts located in key markets throughout the world can reduce the time, complexity and risk involved in securing full compliance of naturally colored products. With technology and application centers located around the world, the experts are interconnected and draw upon each other's expertise.

Critical questions in the regulatory process:



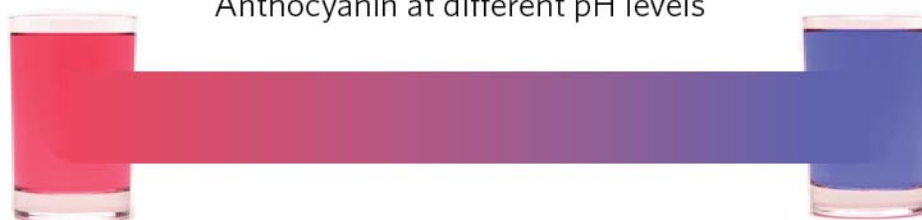
# Acid to Base:

## How pH and Acidity Impacts Color



There are two distinct considerations regarding the pH of a food system and the impact on color. First consideration is that some colors' hue is pH dependent. For example, some anthocyanins are red and pink at low pH, but when used in products like a dairy based product with neutral pH, it will turn bluer. Secondly, certain naturally sourced colors, most notably annatto, carmine and chlorophyll, are known to be truly water soluble at high pH. As a result these colors might precipitate, and sedimentation can form in the solution at low pH. Both considerations can be overcome by selecting a shade solution appropriate for a given pH-level and by using an acid-stable form of color, which is typically achieved either through encapsulation technology or other formulation techniques.

Anthocyanin at different pH levels



Soft Drink Media, pH=3.0

Tap Water, pH=6.5



# Macro Ingredients:

## How Your Food Composition May Impact Color Selection

Red shade beta-carotene  
in LOW fat frosting



Red shade beta-carotene  
in FULL fat frosting

Adding natural color to a food or beverage system is not a simple process. There are lots of possibilities, but here's a few things to be aware of during the development process. You should give the choice of color as much attention as you would give the flavor.

Most finished foods have a target range for fat, protein and carbohydrate. Shifts in either direction can influence color. Obviously, fat, protein content and incorporated air impacts color intensity. The same pigment at the same dosage will provide a different hue in a nonfat and whole milk yogurt. A pigment like beta-carotene has a red-orange shade in a low-fat food matrix like cake frosting, and can shift towards a more yellowish shade if the fat content is increased. In ice cream, increased amounts of air whipped into the ice cream can lighten the shade.

Sugar and dry matter content may influence color stability. Stability is often better in a full sugar matrix than a reduced-sugar or no-sugar version of the same food product as sugar generally stabilizes colors.

Background color, which is the color that the base ingredients bring to the product matrix, influences final color appearance. Naturally occurring color in some red berries like strawberries are very heat sensitive. In a fruit preparation, strawberries will brown during heat treatment or during the shelf life period.

Something as simple as water can influence the final shade, and high-minerals content can influence color shade and intensity slightly. Using purified water in production can improve color performance.

As nearly all components of a food system can influence color shade and stability over time, Chr. Hansen has developed application specific natural color ranges to ensure using pigments that work optimally. These natural colors are ideal in everything from ice cream to juice drinks to baked goods, and includes a diligent library with product cost-impact, real-life stability and process considerations, easing your product development process.



Vegetable soup  
without color



Colored  
tap water



Colored  
vegetable soup

Final color appearance can be impacted by the background color of other coloring ingredients or physical changes during production.



# Fortification:

## Good for the Body, Not Always for Color Stability

The trend of adding extra nutrition in the form of vitamins, minerals and other functional ingredients to food and beverage systems shows no signs of abating. Each functional ingredient behaves differently in a food system, and their interactions can be erratic. Formulators must evaluate in real-time shelf life studies how these ingredients impact color stability. For example, whereas vitamin C (ascorbic acid) is beneficial for avoiding carotenes oxidation in most orange drinks, in high concentrations it destabilizes anthocyanins which is the natural red polyphenols pigment found in red fruits and vegetables, leading to fading and browning effects.

Mineral ions like zinc can complex bind with pigments if not added at optimal pH level and create precipitation. It can be avoided if added in the right order. Other divalent ions minerals like calcium or magnesium can also complex bind with anthocyanins leading to faster fading to light. Same ions when added in large concentration may interact and destabilize color emulsions, creating cloudiness or accelerating ring apparition. Such complication can be avoided using the optimal mineral forms or if added in the right order.



# Flavors:

## Potential Unpredictable Complex Systems



Flavors might appear on ingredient statements as simply “artificial” or “natural,” but in either form, they are anything but simple, which is why flavor and color selection must take place in tandem during product development. Flavors are complex systems that often involve various carriers and solvents; thus, flavor systems are not interchangeable in formulations unless they have been evaluated and proven to be stable in real-time shelf life testing. Further, many formulators convert colors and flavors simultaneously, and colors that are stable with an “artificial” flavor system are not necessarily functional with a “natural” flavor compound for two reasons.

First, natural flavors tend to be weaker in flavor strength, and therefore a higher dosage is required to achieve the desired flavor. The addition of more flavor increases the concentration of reactive carriers and solvents. Second, some natural flavors are based on essential oils, which is a nuisance to natural colors. Most reactions to these unpredictable flavor components are delayed, taking place over weeks, even months, depending on the system.

For example, in beverages, solvents from the flavor can break down color emulsions, resulting in undesirable neck ringing. Another example would be essential mint oils used in confections, which can degrade the pigment so the color fades. To counter these unpredictable behaviors Chr. Hansen have long experience working with flavor providers to deliver functional solutions based on your product need. Therefore it is advised to bring in your color supplier early in the development process.



# Product Development:

## When and How to Add Natural Colors in Production

Beet at No Heating



Beet at High Temperature  
Short time  
185°F in 20 seconds



Beet at Ultra High  
Temperature  
285°F in 4 seconds



As chemically artificial colors are robust, they could be added to a food system at any point and the end result was consistent. Production processes can greatly alter the appearance of natural colors as they are influenced by heat, shear, pressure and exposure to oxygen.

What works in the pilot plant may not work in full-scale production, as the manufacturing environment often changes both scale and variables. In a production setting there are commonly three critical notions.

First and foremost, stability to heat varies by color pigment and color formulation. As an example, heat sensitive pigments like red beet could be added after pasteurization in a UHT treated dairy product, and instead of browning it will provide a beautiful red shade.

Second, the level of shear encountered impacts natural colors. High shear can stress both emulsified color solutions and pigments with a natural high content of protein. The stress can result in emulsion break down or create excessive foaming.

Finally, in products that are extruded, such as cereals, snacks or licorice, the high temperatures combined with high pressures heavily impact colors sourced from nature. In such cases stabilized colors, like encapsulated colors, that imitate how pigments are protected in nature can help mitigate the production process impact ensuring vibrantly colored products.

Chr. Hansen works closely with customers in their production environment to ensure the lab-to-production process runs smoothly. Years of real-life experience in the production environment and a passion for natural colors allow us to share best practices so that your vibrantly naturally colored product remains a consumer favorite.



Chocolate dragees with uniform and mottled surface. Spotted panned products occur when water is trapped between sugar layers resulting in recrystallization. Mottling can be avoided by ensuring proper drying, using high strength colors, controlling sugar inversion or adjusting the syrup composition.



# Packaging:

## Why the Type and Level of Transparency Matters

Consumers buy with their eyes, and they love to see the actual food or beverage through the packaging. Package shape, material and size all have influence on how the color shade and the product is perceived by the consumer.

For example, a soft drink in a bottle with a small diameter will appear lighter than the same drink in a bottle with a larger diameter. The fact that the color shade might look different, dependent on the size and shape, makes it important that the shape of the container or the product is consistent when matching colors.

When most formulators think about package impact on color, they focus on oxidative breakdown caused by exposure to light and oxygen. And rightfully so, as many natural colors can be sensitive to either or both. Pigments like carotenoids are sensitive to oxygen. Other pigments like turmeric are sensitive towards UV light.

Oxidative or light stability is influenced by package composition, packaging materials and storage conditions. Very thin transparent PET bottles are often used because they are more convenient to carry home than a glass bottle, but the challenge here can be the permeability of oxygen through the bottle which is increasing the risk of pigment oxidation.

Solutions to thin bottles would be to incorporate packaging material barriers like UV filters or sleeves, which can slow or prevent oxidation and can prolong colors shelf life period up to 50%.

Packaging type, size and form can directly impact color perception. The same color dosage is used across the three containers



Same solution (dosage%) in different containers.

## Natural Colors are Real Food

Colors help consumers understand what they are eating and, consumers buy food that looks appetizing, making color that first frontier in the purchasing decision, surpassing other attributes like price and flavor. As consumers are becoming more focused on improving their health, they request good quality food with a cleaner label made from natural ingredients.

It may seem like a bigger challenge to find the right natural color, but unique application knowledge and over 140 years' experience with use and production of natural colors, we can guide you smoothly through the conversion process to help you get it right the first time.

We are striving towards making natural colors more affordable and more stable through careful natural selection and breeding of fruits and vegetables. We are continually improving production methods and using advanced color formulation technologies to deliver higher color intensity and stability.

As you are making this naturally sourced color investment, Chr. Hansen hopes you have found this guide useful. We look forward to partnering with you to identify ideal solutions for your brand.