Super-Stable Colors that pass the test

How Lycored's natural colors perform in beverages and fruit preparations





Background

We're in the middle of a sea change in attitudes to colors in food and beverages. It's no longer enough for products look good — customers now demand that the colors that make them appealing are achieved safely and naturally. More than three in five consumers globally say they try to avoid artificial colors.

Manufacturers who make the switch from artificial to natural reap the rewards. When 506 health-conscious consumers were asked "Would you be willing to pay more for a product with natural flavorings and colors?" almost nine in ten said they would. On average they said they would pay up to 47% more.

However, going natural can also be technically challenging. Some non-artificial colors are sensitive to pH, UV light and extreme temperatures, and may not interact well with some recipe matrices, such as high fat systems.

Lycored therefore works closely with manufacturers to make it as easy as possible for them to get the benefits of the switch to natural without sacrificing stability.

In line with that commitment, we carry out frequent research into the stability of our natural color solutions. This paper outlines the results of recent stability tests in three categories: flavored and colored sparkling waters; UHT-treated, colored, flavored milks; and fruit preparations for layered yogurts.



Lycored's own grown natural color solutions

With consumer preference for natural growing, and manufacturers seeking product stability, Lycored's super-stable colors are the perfect solution.

Using a range of proprietary techniques and our own plant sources, Lycored has created a wide range of versatile carotenoidbased color solutions. At the source of our colorant family are the carotenoids Lycopene from Tomato and BetaCarotene from our own strain of Blakeslea Trispora fungus.

Both Lycopene and BetaCarotene offer several advantages over other natural

Lycopene

- Provides authentic, vegan pink to red shades
- Highly stable under a wide range of pH, light and high-temperature conditions
- Stable in products containing Vitamin C (ascorbic acid) – in fact the vibrancy of our red shades are amplified with its addition
- Shade variations and formulations suitable for high fat systems
- Greater versatility than other naturally sourced red options (beet is sensitive to heat, anthocyanins are sensitive to pH, and carmine is not consumer-friendly)
- Well known by consumers

BetaCarotene

- Offers a spectrum of natural, vegan yellow to orange shades
- Shade variations and formulations for a wide range of food and beverage applications
- Highly stable under a wide range of pH, light and high-temperature conditions
- Stability is amplified with the addition of Vitamin C (ascorbic acid)

Both are certified kosher and halal, vegetarian-friendly, non-GMO, heat, light, and pH stable, safe and easy to use.

Testing the stability of Lycored's natural colors in beverages

Lycored set out to test the performance of its natural colours in flavored and colored sparkling waters – one of the beverage categories for which they are ideal.

Methodology

Results

Researchers assessed the stability of red to orange to yellow shades including:

ResilientRed A, ConstantCrimson A, OrangeOvation B, OrangeOvation C Clear, StellarYellow A, StellarYellow C Clear.

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Sparkling water was added to strawberry flavored syrup and filled to 250ml in PET bottles, with 200ppm of ascorbic acid added to prevent color fade over a 12-month shelf life. Each sample was checked for ringing, sediment and fade at regular intervals. Six of the seven Lycored colors delivered good stability over 12 months (ConstantCrimson A delivered good stability up to nine months). There was no ringing at all over 12 months in four of the samples, although there was a slight stain of the PET neck after nine months in the samples colored with ResilientRed A and ConstantCrimson A. There was no ringing in the sample colored with StellarYellow C Clear for the first seven months.

There was no sediment in five of the seven samples, although in those colored with ResilientRed A and ConstantCrimson A, there was a slight sediment in the base of the bottle at the end of the 12 months.

Clarity was good at the end of 12 months for StellarYellow C Clear and ResilientRed A. The other colorants provide provide natural cloudy effect from the outset and all four retained their natural cloudiness, which means no added cloudifiers are required.

The only flavored water which faded was the one colored with OrangeOvation C Clear in which there was some fade (but only after six months).

In summary, the red, orange and yellow shades from Lycored delivered excellent performance in sparkling flavored waters.



Super-Stability in UHT treatment processes

Lycored has also recently demonstrated the stability of its natural reds in another beverage category — UHT milk drinks. Three strawberry flavored milk drinks were prepared, one colored with ResoluteRuby A, one with ConstantCrimson A, and one with Red 3, an artificial colorant. The drinks were subjected to four different UHT process technologies: steam injection, plate, tubular, and infusion. In many of these processes, such as steam injection, the recipe is heated above 145° C / 293 F and held in direct steam for over five seconds, which is very rigorous. With all UHT process they were also subjected to upstream or downstream homogenization process.

Immediately after UHT & homogenization treatment, the researchers measured the samples for any changes in color using HunterLab's color measurement software and the DeltaE method of calculation. Under this system, a DeltaE score of 2 or below indicates that there has been no change that is visible to the naked eye.

ResoluteRuby A and ConstantCrimson A both performed exceptionally, with the samples that had been subjected to the harshest direct injection treatment achieving DeltaE scores of 0.52 and 0.67 respectively. Red 3, by contrast, scored 10.55, showing that this artificial color had experienced a dramatic variation in color during the direct injection process.



Artificial color Red 3 ResoluteRuby™ ConstantCrimson™

We also evaluated the performance of the colors in accelerated shelf life tests, which simulated the harshest possible conditions during transportation and storage and whilst on sale in store.

In a test to determine the color stability of the UHT strawberry drinks in ambient conditions, the Lycored red shade drinks also performed well. After six months at ambient temperatures of between 25 and 40°C, there was no visible difference in the color of the Lycopene based red shade drinks, with both registering DeltaE scores of 2 or under. However, there was a marked difference in the color of the Red 3 drink (DeltaE score of over 9). This demonstrates that drinks colored with ResoluteRuby A and ConstantCrimson A will retain their color over a long ambient shelf life.



Artificial color Red 3 ResoluteRuby[™] ConstantCrimson[™]

The drinks were exposed for extended periods to 24/7 light (6000 lux – equivalent to over double that of a typical retail environment) to test their light stability. This is a limiting factor with colors based on beetroot or turmeric, and precludes their use in UHT products that are designed for a chiller cabinet environment or packaged in a transparent or sleeveless bottles. After 36 days, the Red 3 drink displayed a significant color variation (DeltaE score of 17), whereas there was no discernible change in the brightness of the Lycored colored drinks, confirming their suitability for the chiller aisle.



In a final test, the drinks were kept in an incubator in the dark at a temperature of 40°C, to establish their ability to remain stable during warehousing and transportation. The Lycored color samples were able to withstand 40oC heat in incubation conditions over 30 days without any discernible impact on color, but the color of the Red 3 sample underwent a considerable variation. This shows that drinks colored with ResoluteRuby A and ConstantCrimson A can be stored and transported via ambient rather than cold chain distribution - particularly beneficial in hotter climates.

Avoiding bleed in fruit preparations for yogurts

A range of natural color sources are commonly used in fruit preparations in yogurts. These include lycopene and other carotenoids, foodstuff colorings such as carrot concentrate, paprika and carmine.

Lycored set out to explore the comparative stability of its natural colors in this category. It aimed to understand:

- How adding color to fruit preparations creates lasting visual impact
- The authenticity of Lycored's fruit preparation color shades compared to real fruit varieties, and how this changes over time
- The stability over time of Lycored colors in a retail lighting environment, versus common alternatives
- How Lycored red colors withstand migration into white dairy mass in yogurt, and how their performance compares with that of carmine
- The stability of Lycored's colors through a process of industrial scale-up

Stored in light cabinet

Carrot Concentrate

Paprika

Lycopene

BetaCarotene

No added color

Carrot Concentrate

Key

Phase 1 – Shelf life tests

In Phase 1 we monitored and assessed the comparative appearance of yogurts containing fruit preparations over a shelf life of 31 days.

Twenty-four unique samples were tested. Each sample of 100g full fat Greek yogurt contained 40g of preparation from four common fruit varieties – lemon, apricot, peach and strawberry.

For each fruit variety, at least one sample contained an appropriate Lycored colorant and at least one contained an alternative natural colorant. For some of the samples we also assessed the performance of fruit preparations with no colors (comparing them to at least one each of the Lycored red, orange and yellow shade range).



Lemon: StellarYellow C Clear, Paprika



Strawberry: ConstantCrimson C, ResilientRed A, No Color



Apricot: OrangeOvation A, Carotene



Peach: Carrot concentrate, StellarYellow A, No Color

The samples were all tested in two different stability environments. In one, temperature was controlled at 4° C for 30 days. In the second, temperature was controlled at 4° C for 30 days under light of 2,200 Lux.



Results



In the yogurt containing **lemon** preparation, there was significant fade and migration in the sample colored with paprika, compared with the sample colored with StellarYellow C Clear.



In the **strawberry** samples, there was severe migration from the carmine-based colorant, compared with the samples colored with ResilientRed A and ConstantCrimson C. This was the case even in the samples containing pectin. There was also significant fade and distortion from the sample containing fruit preparation with no color.



In the yogurt containing **apricot** preparation, OrangeOvation A delivered high vibrancy and lack of fade compared to the carotenes sample. This was the case even in light cabinet conditions (double the typical grocery chiller cabinet temperature of circa 750 to 1000 Lux).



In the **peach** yogurt, there was significant fade and migration in both the sample with no colorant, and the sample colored with carrot concentrate. By contrast StellarYellow A delivered far higher stability.

Conclusions

The trials from Phase 1 demonstrate that:

- Fruit bases or preparations in yogurts need added color to retain vibrancy and fresh appeal
- Lycored's natural colors are color-fast even under light conditions more extreme than retail lighting conditions
- Lycored's natural colors offer authentic true to fruit and vibrant fruit shades from lemon yellow to strawberry red
- Migration is a real issue for carmine based coloring in strawberry, even when paired with pectin

Phase 2 – Industrial Scale up

In Phase 2 we assessed the stability of four of Lycored's natural colorants under the stronger and longer heat process of scaled industrial production. We looked at:

- Lemon: StellarYellow C Clear
- **Apricot:** OrangeOvation A
- Peach: StellarYellow A
- Strawberry: ResilientRed A and ConstantCrimson C

We wanted to assess how stable they were when heated to 75° C, 85° C and 95° C. We commissioned external researchers to take Digieye pictures and lab measurements to give an objective set of results.

In each of the samples, the colors remained stable at 95° C when held at that temperature for over 30 minutes.

The tests show that Lycored's natural BetaCarotene and Lycopene colorants are both process stable, even when subjected to high heat levels and holding temperatures over 30 minutes.

BetaCarotene can be tailored to achieve multiple fruit shades for lemon, pineapple, apricot, peach, mango. Lycopene delivers red shades for authentic strawberry and raspberry fruits that maintain their vivid hue and do not fade to purple when blended into yogurt. Both are process stable and stable to UV light in a chiller cabinet .

Manufacturers who use Lycored's true to fruit colors in fruit preparations in yogurts can achieve both vivid impact and high stability.



Conclusion

Manufacturers now have greater opportunities than ever to color products naturally without compromising on stability. In fact, rather than creating limitations these super stable colors offer new ways to position products as more natural and fresh, with longer shelf life. They can also potentially reduce the operational costs involved in packaging, transport and storage of final product.

Every day we are learning more about the possibilities offered by our natural colorants and showing that they demonstrate stability in a growing number of applications. Frequently we discover that they outperform not just other natural alternatives, but also artificial colorants.

There is a long-standing perception that natural colors are harder to work with than artificial alternatives. We are working towards a day when that is a thing of the past.

For more information, or to download a brochure, visit: http://connect.lycoredfoodhub.com/super-stable-colors/

'Nielsen 'What's in our food and on our mind: Ingredient and dining-out trends around the world' August 2016 http://www.nielsen.com/content/dam/nielsenglobal/ eu/docs/pdf/Global%20Ingredient%20and%20Out-of-Home%20Dining%20 Trends%20Report%20FINAL%20(1).pdf

²Lycored 'True Colors: Consumer Preference for natural colors and what it means for dairy" http://www.lycored.com/wp-content/themes/lycored/dist/images/true-colors-paper.pdf



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