



## Resilient reds that endure.

Natural reds emerge as the best performers in UHT stability tests.

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**Lycored tested the stability of two of its natural Tomat-O-Red<sup>®</sup> colors versus the artificial colorant Red 3 (Erythrosine) during and after UHT (ultra high temperature) processing in a flavored milk drink matrix. Accelerated shelf life tests were carried out to evaluate the stability of the colors when exposed to light, dark and ambient conditions, simulating real-life storage, transportation and retail environments.**

**The natural colors outperformed the artificial color across all tests, demonstrating that there are considerable advantages to selecting Tomat-O-Red over other artificial or natural colors for UHT applications.**

## Consumers make the natural choice

- Consumers everywhere are voicing a clear preference for natural rather than artificial colors.
- According to Nielsen's August 2016 report on ingredient trends, 61% of consumers internationally say they try to avoid artificial colors, rising to 65% in the Asia-Pacific region. Savvy food and drink manufacturers are responding to this strong consumer sentiment by replacing artificial colors with natural colors in recipes. The number of new product introductions with natural colorants in Europe grew by 5.6% in 2015, compared to a decline of 5.2% for artificial colors.
- This long term shift away from synthetic colors and towards natural ones is expected to continue for the foreseeable future, as more and more food and drink manufacturers convert to natural. Those who don't, risk alienating consumers and turning them on to alternative products that have embraced the natural trend.
- However, natural colors can be more challenging to work with. In particular, they tend to be more sensitive to pH, UV light and extreme temperatures. In some food and drink applications, these technical barriers make it difficult to find a stable natural replacement.

## Ultra challenging applications

One problem application is UHT treated dairy products, such as flavored milk drinks. Manufacturers of these products have historically been reluctant to switch to natural colors owing to concerns about their ability to withstand the UHT process and remain stable throughout the product's shelf life at ambient conditions.

Indeed it is true that natural colors can be prone to fading or degradation when subjected to heat processing, and that the higher the temperature, the more marked the color loss is likely to be.

In direct UHT heating or 'direct injection', steam is briefly injected into the product, and this is rapidly followed by flash cooling. The brevity of the treatment makes it possible to achieve very high product quality, but the exposure to temperatures of 143°C, albeit brief, can be at the expense of color degradation. With indirect heating, the product does not come into direct contact with the heat source, but is instead heated using heat exchangers. Whilst slightly less harsh than direct methods, indirect methods still subject the colors to temperatures of over 120°C and may therefore lead to color loss.

The last few years have seen the development of natural green, yellow, orange, and brown colors that are suitable for use in UHT applications. However, finding successful and robust red/pink natural alternatives has been more problematic, with the colors either being destroyed immediately after processing, changing shade under the neutral pH conditions or fading during storage.

Lycored has drawn on 20 years of lycopene research to come up with a stable natural color solution that offers unrivaled technical performance in UHT applications. Our Tomat-O-Red range of lycopene-based pink to red colors is derived from non-GM tomatoes grown on farms in Israel and California. Drawing on the power of carotenoid-based pigmentation, they offer a more robust alternative to sensitive natural colors such as beetroot and anthocyanins, as well as carmine, which is not vegetarian-friendly.

**What's more, a recent study conducted by Lycored found Tomat-O-Red to be even more stable than artificial colors in a UHT flavored milk drink matrix.**

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## Reds put to the test

Lycored ran a trial to establish the stability of its Tomat-O-Red colors following UHT processing.

Three strawberry flavored milk drinks were prepared, one colored with Tomat-O-Red R, one colored with Tomat-O-Red RP and one colored with Red 3, an artificial colorant. The drinks were subjected to four different UHT process technologies, including the direct injection technique.

### UHT stability

Immediately after the UHT 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.

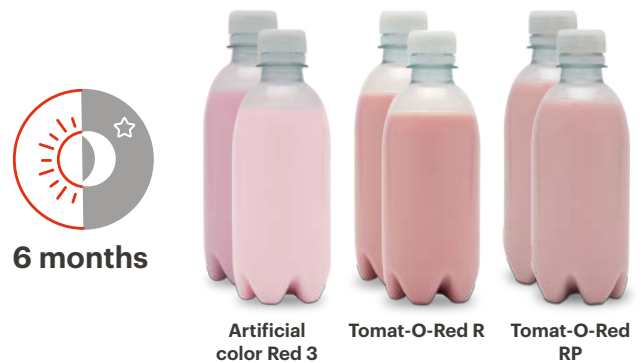
Tomat-O-Red R and Tomat-O-Red RP both performed exceptionally in this test, with the samples that had been subjected to the harshest direct injection treatment achieving DeltaE scores of 0.52 and 0.67 respectively. Red 3, by contrast, scored 10.55, showing that this artificial color had experienced a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



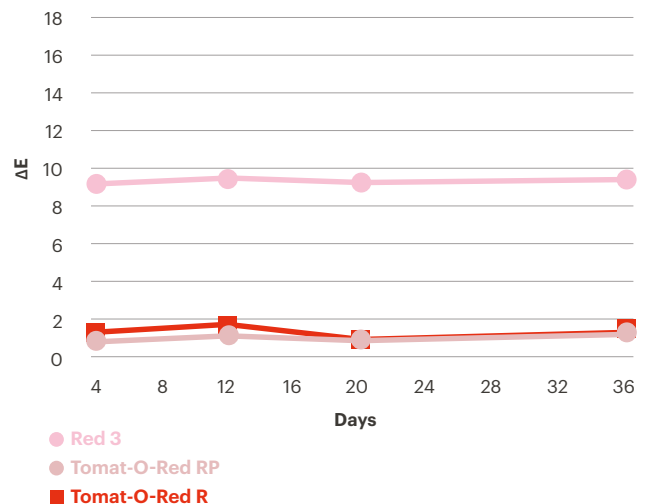
### Accelerated shelf life tests

Lycored's scientists also evaluated the performance of the colors in accelerated shelf life tests. These 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 Tomat-O-Red drinks outperformed the drinks made with the artificial color Red 3. After six months at ambient temperatures of between 25 and 40°C, there was no visible difference in the color of the Tomat-O-Red 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 Tomat-O-Red will retain their color over a long ambient shelf life.

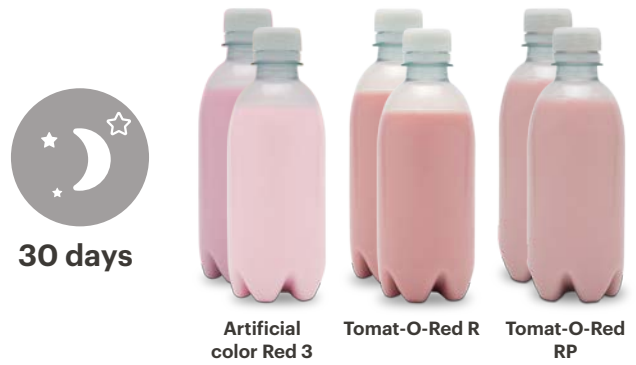


**Table 1: Ambient conditions - UHT Injection Downstream**

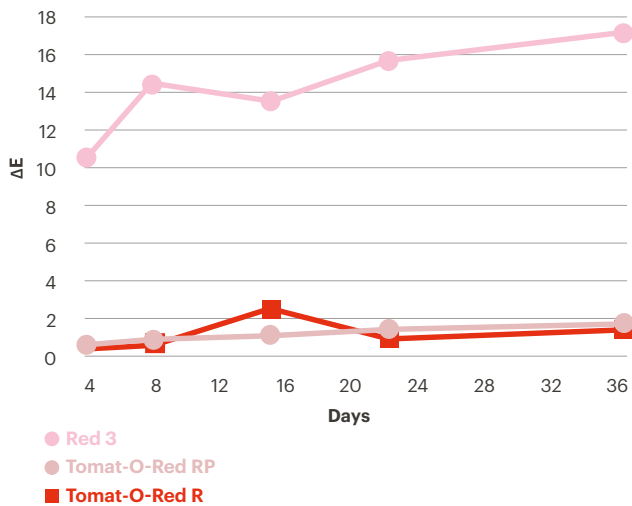


The drinks were exposed for extended periods to 24/7 light (6000 lux) to test their light stability. This is a limiting factor with colors based on beetroot or turmeric, and precludes their use in UHT products that are designed for a chiller cabinet environment or packaged in a transparent or sleeveless 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 Tomat-O-Red colored drinks, confirming their suitability for the chiller aisle.

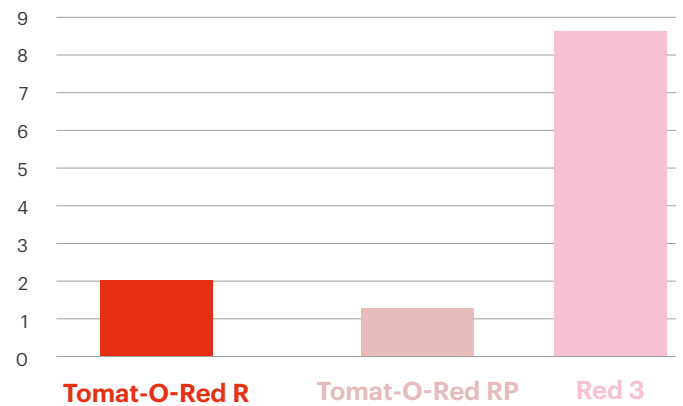
In a final test, the drinks were kept in an incubator in the dark at a temperature of 40°C, to establish their ability to remain stable during warehousing and transportation. The Tomat-O-Red samples were able to withstand 40°C heat in incubation conditions over 30 days without any discernible impact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



**Table 2: Light Stability - UHT Injection Downstream**



**Table 3: 30 Day Incubator Stability - UHT Injection Downstream**



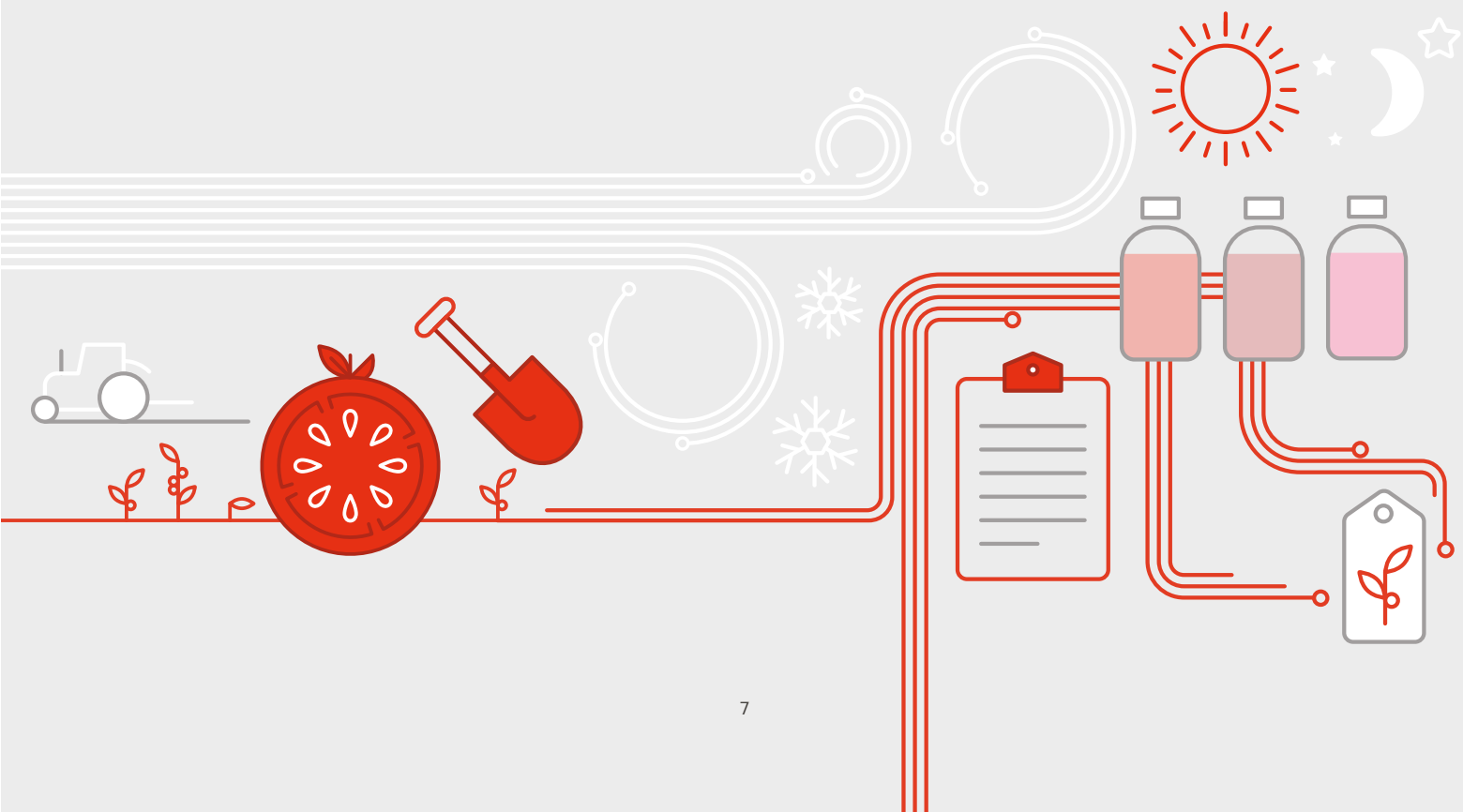
## Color with confidence

In summary, the trial proved that Tomat-O-Red natural colors can withstand even the most demanding processing and storage conditions. They are more robust, have a longer shelf life and offer more packaging, display and storage flexibility than their artificial counterparts. This has far-reaching and exciting implications for manufacturers of UHT milk products who may have been deterred from switching from artificial to natural colors due to quality and stability concerns.

From a marketing and positioning perspective, this opens up much-needed opportunities for developing milk beverages with a 'natural' or 'free from' sell, in a category that is currently lagging behind in this respect. Tomat-O-Red can simply be declared as 'lycopene from red tomatoes' on the label, allowing companies to achieve much sought after clean label status that has thus far eluded this category. It also gives manufacturers of UHT milk products access to the chiller cabinet, and with it, the chance to give their products a fresher and more natural positioning.

### Benefits of using Tomat-O-Red versus artificial colors

- Can withstand even the most demanding processing and storage conditions
- Longer shelf life and more packaging, display and storage flexibility than artificial colors
- Clean label status, can be declared as 'lycopene from red tomatoes'
- Enhances the natural positioning of products





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