# The Search for a Red 3 Replacement

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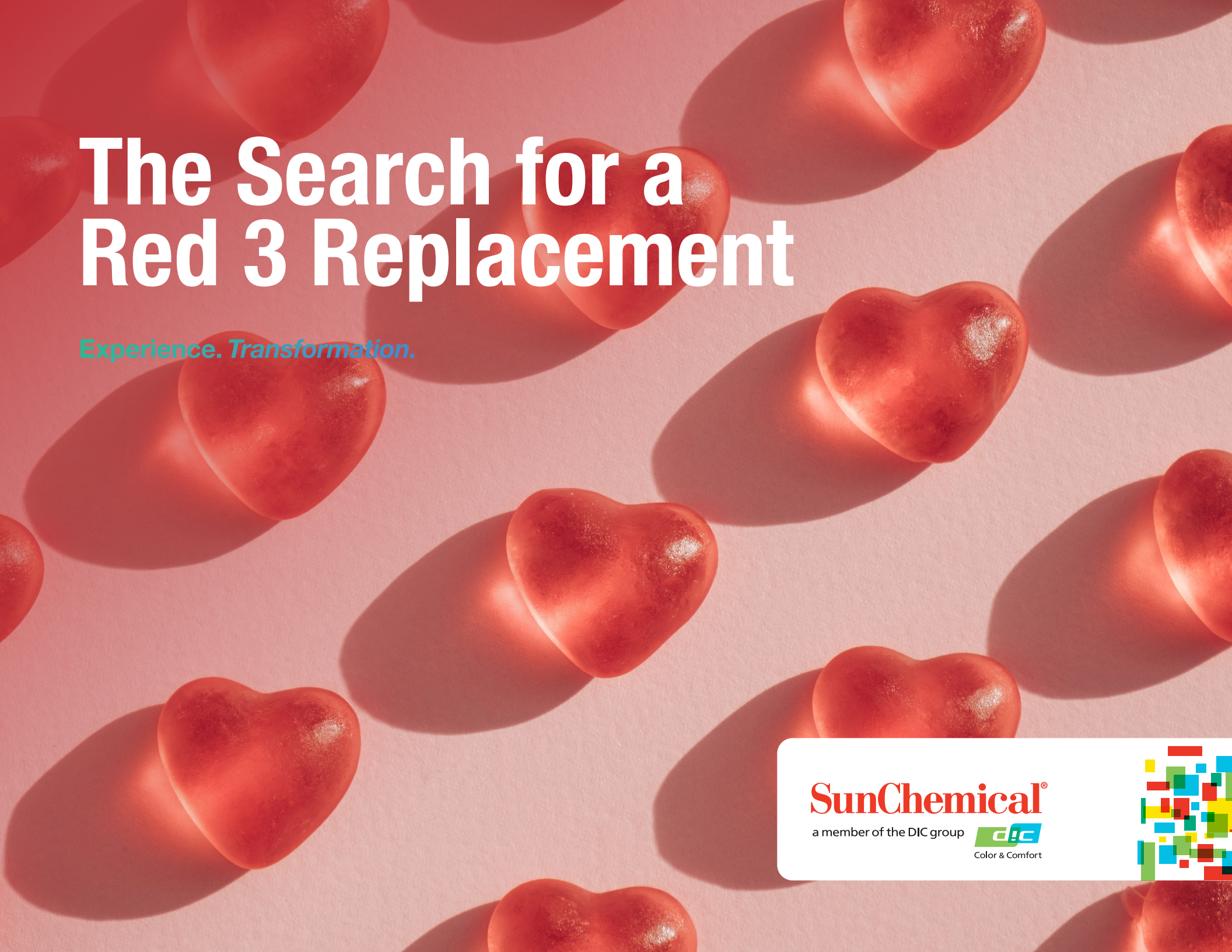

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# Background on Red No. 3

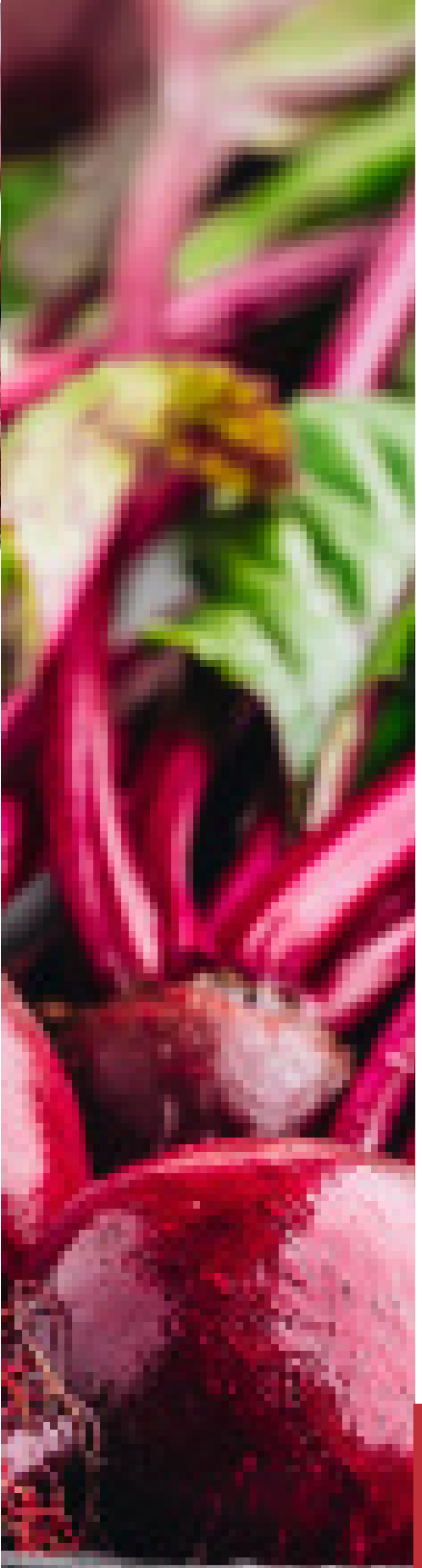
## Old Reliable?

FD&C Red 3, also known as erythrosine, has excellent heat stability and is primarily used to add a red or pink color to food such as confectioneries, bakeries, and beverages. Though FD&C Red 3 is insoluble in low pH and its light stability is poor, it has been adapted and formulated in various food and beverage applications. Since the 1930s, FD&C Red 3 has been approved by the FDA and is allowed for use in foods, dietary supplements, and oral drugs, but banned for use in cosmetics or externally applied drugs. If the dye is used within its approved limits, the FDA states it is safe to consume.

However, petitions and legislative proposals on FD&C Red 3 are driving the market to look for alternatives. In October 2022, The Center for Science in the Public Interest, a public health advocacy group, petitioned the FDA to remove FD&C Red 3 from the list of color additives approved for use in food and dietary supplements. In February 2023, California introduced legislation that would ban the sale of processed foods that have certain chemicals, including FD&C Red 3. New York issued the same legislation to prohibit FD&C Red 3 shortly after.

### What's next?

In response to the evolving regulatory landscape and potential permanent ban of FD&C Red 3, studies and research have been conducted to search for alternative solutions. Naturally derived red colorants have their own characteristics in terms of light, temperature, and pH stability. Depending on the specific applications, label requirements, processing conditions and formulation, the recommendations of colorants and concentrations will vary. The most derived natural colorants are beet, berries, grapes/currants, and Cochineal. Since they are naturally derived and the compositions are more complex than synthetic FD&C Red 3, it requires good understanding of their unique characteristics to decide the best alternative for food and beverage applications.



## Beet

Beetroot is a part of a beet plant, known as beets in North America, while the vegetable is referred to as beetroot in European regions. Red beets have a pigment called betanin that provides a magenta hue; they are inexpensive and can be used in applications with pH ranges from 3-7 and mild processing temperatures.

### Labeling

On a food label, beet color is typically labeled as “Beet Juice Concentrate” or “Beet Extract.” It is accepted as food color E162 in the EU and approved by the FDA under 21CFR 73.40. This labeling is used to prove that the color of the food product is derived from the natural pigment of beet.

### pH Stability

Betalains are prone to changes in pH levels, and their color can be affected by acidic or alkaline environments. The color quality will be dependent on these conditions and to what it is exposed. In acidic conditions (low pH), such as in products with a pH below 4, the red color of beet pigments tends to be relatively stable and retains its vibrancy. However, in alkaline conditions (high pH), such as in products with a pH above 7, the red color may become less stable and become more yellowish or brownish.

### Heat Stability

Generally, beet color is not very stable. When exposed to temperatures of 70 Celsius and above for an extended period, the color may degrade and cause a decrease in intensity. Processing beets at elevated temperatures can alter their color from vibrant red to a duller brownish red.

### Applications

Due to Beet Red’s unique characteristics, they are commonly used in gummy, ice cream, and smoothie applications. When used properly, Beet colors can replicate the color hue and intensity of FD&C Red 3, as well as similar stability.

## Anthocyanins

Anthocyanins are a group of water-soluble pigments that contribute to the vibrant red, purple, and blue colors in fruits, vegetables, and other plant-based foods. Food that has anthocyanins include berries, currants, grapes, cherries, red cabbage, plums, purple sweet potatoes, black carrots, and much more.

### Labeling

Anthocyanins can be extracted from a variety of sources and are labeled as E163 in the EU, while in the US, the source of anthocyanins dictates the entry in 21 CFR and corresponding requirements for compliance.

### Shade Shifters

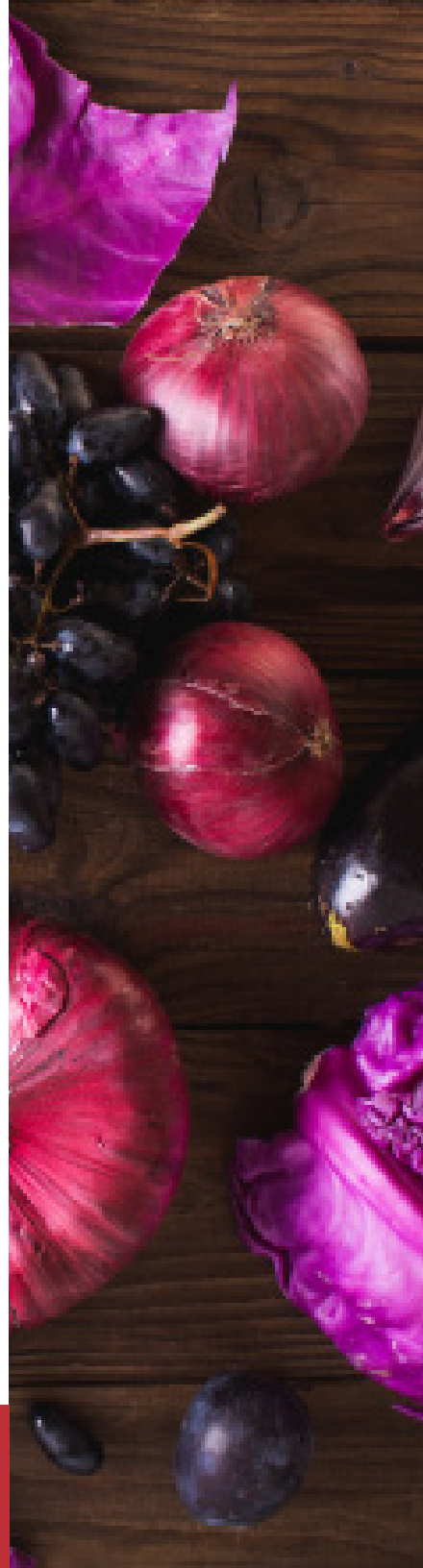
Anthocyanins can be distinguished by the pH of the surrounding environment known as" pH-dependent color changes." The color changes are caused by the structural changes of anthocyanin molecules due to variations in acidity (pH). In an acidic environment (low pH), anthocyanins appear to be redder and provides a more secure environment. In a pH range of 3-7, anthocyanins are a purple or blue shade, but in an alkaline environment (high pH) the colorant may appear green.

### Stability

Anthocyanins are generally not very heat-stable, meaning they can degrade or lose their color when exposed to high temperatures for an extended period of time. Heat can alter the pH of the surrounding environment, affecting the color of anthocyanins. To reduce the loss of anthocyanins during the process, it is recommended to use gentle cooking techniques and avoid prolonged exposure to hot temperatures. Color degradation can also be reduced by adding acidic ingredients to stabilize the red form of anthocyanins.

### Applications

Due to their unique characteristics, they are more commonly used in applications such as beverage, popsicle and icing applications to replicate color hue and intensity of FD&C Red 3, as well as similar stability.



## Carmine/Cochineal

Carmine is a red pigment that is derived from cochineal insects, particularly from the female insect species Dactylopius coccus. When carminic acid is extracted, they can produce a vibrant red color. It is usually labeled as “carmine,” “cochineal extract,” or “E120” in ingredient lists.

### Labeling

Carmine is usually labeled as “Carmine”, “cochineal extract”, approved as E120 in the EU, and follows FDA 21CFR73.100. It is important to note that carmine is considered a naturally derived colorant, but it is not suitable for vegans and vegetarians, nor can be labeled as Kosher or Halal due to its cochineal origin.

### Stability

Carmine color has a wide range of pH (3.5–8) and has excellent heat and light stability. In acidic conditions (low pH), carmine tends to be more stable and retains its red color. It can tolerate moderately acidic conditions without significant degradation, and thus it is often used in acidic food products such as fruit-flavored beverages, yogurts, and certain confectioneries.

### Applications

Due to Carmine’s unique characteristics, they are commonly used in bakery, hard candies, and dog biscuits. They are the most effective choice among all alternatives.

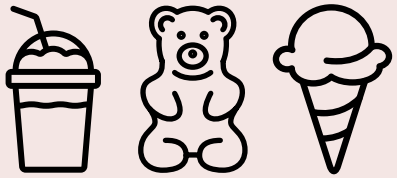

# The Search for a Red 3 Replacement

FD&C Red 3 has been utilized for almost a century and has the potential to be very stable and cost-effective. However, due to the growing concerns of consumers about the changing regulatory landscape, we propose SUNFOODS™ product offerings that can replace FD&C Red 3 in various applications.

In the SUNFOODS™ natural colorants portfolio, we offer a variety of concentrations, physical forms, and compatibilities to ensure they meet the application requirements. Contact your account manager and application team to find the best solutions for your application requirements.

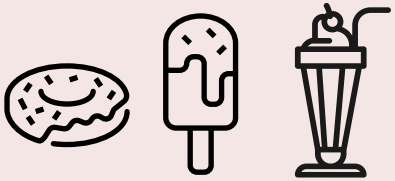
## SUNFOODS Beet

SUNFOODS™ Beet portfolio offers a balanced solution of cost and performance in comparison to other available natural alternatives in replacing FD&C Red 3 in gummy, ice cream and smoothie applications.



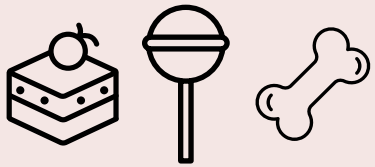
## SUNFOODS Anthocyanin

SUNFOODS™ Anthocyanin portfolio offers a variety of products and features to replace FD&C Red 3 in beverage, popsicle, and icing applications.



## SUNFOODS Carmine

SUNFOODS™ Carmine portfolio offers a highly stable FD&C Red 3 alternative, and the products can be used in a variety of applications where high heat and light exposure is required such as bakery, hard candies, dog biscuits applications.



# Experience. *Transformation.*

**A partner who transforms with you.**

Today's environment requires more than change. It demands transformation — and a partner who's willing to transform with you. Sun Chemical, a member of the DIC group, is a leading producer of packaging and graphic solutions, color and display technologies, functional products, electronic materials, and products for the automotive and healthcare industries. Together with DIC, Sun Chemical is continuously working to promote and develop sustainable solutions to exceed customer expectations and better the world around us. With combined annual sales of more than $8.5 billion and 22,000+ employees worldwide, the DIC Group companies support a diverse collection of global customers. As you move forward into a world of stiffer competition, faster turnarounds, more complex demands and sustainable products, count on Sun Chemical to be your partner.



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www.sunchemical.com | globalmarketing@sunchemical.com

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