



Replacing FD&C Colors with Caramel Color:

A Practical Framework for Reformulation

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Over 145 years of expertise in Caramel Color and caramel manufacturing

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Executive Summary

The industry shift away from petroleum-based, certified FD&C colors is no longer an emerging trend; it is now a requirement in some markets. Driven by consumer demand for clean labels and mounting regulatory scrutiny, food companies across categories are actively evaluating alternatives.

Caramel Color is one of the world's most widely used color additives for good reasons: it is derived from controlled heat treatment of carbohydrates, can carry a clean label designation, and performs reliably across a wide range of food and beverage applications. But replacing an FD&C color with Caramel Color is not a simple substitution. It requires understanding the ionic chemistry of your product, selecting the correct class, color and form, and accounting for the meaningful differences in how Caramel Color performs compared to FD&C colors.

This formulation guide provides a technical framework for evaluating Caramel Color as a replacement for FD&C colors, covering the market landscape, the four Caramel Color classes, application-specific selection criteria, and the key formulation variables that determine success.

The Market Landscape

Why This Is Happening Now

FD&C colors have been an industry standard for decades; cost-effective, highly stable, and predictable in performance. However, regulatory and market pressures are causing food companies to reformulate their products without FD&D colors.

Three converging forces are driving reformulation forward:

- **Consumer preference:** Research shows that consumers across demographics and product categories prefer products without certified colors when given a choice. For some brands, this has shifted from a marketing differentiator to a category expectation.
- **Regulatory pressure:** In the United States, the FDA finalized its revocation of authorization for Red 3 in early 2025¹, and state-level action is creating broader pressure to remove the FD&C colors from products. These pressures are also reinforced by international precedent.
- **Retailer and brand standards:** A growing number of major retailers and food service operators have established "no artificial colors" standards for their private label and preferred supplier programs. For manufacturers supplying these channels, reformulation is effectively non-negotiable.

Based on the above factors, the question is less of whether to reformulate products with FD&C colors, but how to do it without compromising product performance, shelf life, or consumer acceptance.

Why Caramel Color

Caramel Color holds a unique position. Unlike many other colors, Caramel Color offers:

- Exceptional stability across heat, pH, and light exposure
- A clean, simple ingredient label: "Caramel Color"
- A well-established global regulatory framework
- Wide commercial availability and consistent supply

The tradeoff is that Caramel Color does not replicate the high-intensity, narrow-spectrum hues of FD&C colors. Caramel Color builds color through concentration, and it interacts with food chemistry in ways that require careful matching. Understanding these dynamics is the core competency of successful color replacement.

¹ [FDA to Revoke Authorization for the Use of Red No. 3 in Food and Ingested Drugs | FDA](#)

The Four Classes of Caramel Color

Caramel Colors are divided into four classes, as defined by the FCC Caramel Monograph. The classification is based on the reactants used to manufacture the color and determines the ionic charge of the resulting color.

Class	Process	Ionic Charge	Typical Applications
Class I	Heat treatment of carbohydrates	Neutral to slightly negative	Spirits, dairy, light-colored sauces
Class II	Heat treatment of carbohydrates with sulfite compounds	Negative	Cognac, aged spirits
Class III	Heat treatment of carbohydrates with ammonium compounds	Positive	Beer, soy sauce, confectionery
Class IV	Heat treatment of carbohydrates with both ammonium and sulfite compounds	Negative	Colas, soft drinks, baked goods

The ionic charge of a Caramel Color determines how it interacts with proteins, tannins, and other charged components in your product. A charge mismatch leads to haze or precipitation common failure modes in color replacement projects that used the wrong class for the application.

Formulating with Caramel Color

How Color Works Differently

Before selecting a caramel class, it is important to set accurate performance expectations. FD&C colors achieve color through light absorption at specific wavelengths producing bright, saturated hues at very low usage levels. Caramel Color works differently: it produces a broad-spectrum tone, and the specific hue (from pale golden yellow to deep amber-brown and dark brown) is controlled by class selection and concentration.

This means Caramel Color is well-suited to replacing yellow, orange, and amber-toned FD&C colors. It is not a direct replacement for reds, greens and blues without supplementation. For example, the Caramel Color and spirulina combined creates a green hue. For some yellow and orange color replacement, Caramel Color can achieve commercially acceptable results on its own.

Selection Framework

Target FD&C Color	Recommended Class	Key Consideration	Application Context
Yellow 6 (Sunset Yellow)	Class I; Class II	Class II delivers reddish-orange tones for deeper profiles	Sauces, marinades, snack seasonings
Orange Tones	Class II; Class III	May need to be used in combination with other colors	Seasonings, beverage, sauces, marinades, bakery
Brown/Amber Tones	Class III; Class IV	Wide dosage range; confirm ionic compatibility first	Bakery, cereals, cola beverages

Dosage and Tinctorial Strength

Caramel Color is typically used at higher dosage levels than FD&C colors. A FD&C color may achieve the target hue at 0.005–0.02%, while Caramel Color may require 0.1–2.0% depending on the application and desired intensity. This has downstream implications for:

- **Flavor impact:** At higher concentrations, some caramel colors contribute a mild, characteristic flavor note. This is generally not perceptible at typical usage levels but should be evaluated in flavor-sensitive applications.
- **Cost-in-use:** Per-unit cost comparisons should account for use level, not just raw material price. In many applications, Caramel Color can have similar, if not, advantageous, cost-in-use compared to other FD&C color alternatives.
- **Labeling:** Depending on the use level and the color being replaced, Caramel Color may alter order of the ingredients on the label.

Ionic Compatibility

Every product has a net ionic environment driven by pH, protein content, polyphenol load, and the presence of other charged ingredients. The caramel class must be matched to this environment.

As a rule of thumb:

- **Acidic systems with carbonation (colas, carbonated beverages):** Negatively charged Class IV is essential. A positive or neutral charge will precipitate.
- **High-protein systems (dairy, protein beverages):** Proteins are positively charged at low pH and negatively charged above their isoelectric point, and class selection depends on the specific protein and pH conditions.
- **Tannin-containing systems (tea, coffee, wine-based):** Tannins are negatively charged; a positively charged Class III can cause precipitation. Class I, II, or Class IV is generally preferred.
- **Neutral or mildly acidic systems (sauces, dressings, bakery):** Class I is often the most straightforward starting point.

When in doubt, run a compatibility test before committing to a class. Sethness Roquette's technical team can assist with this evaluation.

Stability

One of Caramel Color's most significant advantages is its stability. The table below compares performance across key stability parameters:

Stability Factor	FD&C Colors	Caramel Color
Light / UV exposure	Can fade under prolonged UV	Excellent light stability across classes
Heat processing	Variable; some degradation at high temps	Survives extrusion, retort, and UHT conditions
pH range	Stable within limited pH bands	Formulated for broad pH compatibility by class
Protein systems	Generally compatible	Charge matching critical to prevent flocking
Shelf life	Proven in long-shelf products	Proven in long-shelf products; class selection matters

It is worth noting that Caramel Color's stability advantage over other colors (beet, anthocyanins, spirulina, etc.) is substantial which is why it is preferred base color, even when supplemental colors are required for adjustment.

Form

Caramel Color is available in both liquid and powder forms. Formulators need to consider:

- **Processing compatibility:** Liquids are typically easier to incorporate in high-volume continuous processes; powders offer advantages in dry blending and lower water-activity applications.
- **Cold-water dispersibility:** For applications without a hot processing step, confirm dispersibility at your target temperature.

U.S., Canada, and International Regulatory & Safety Considerations

Caramel Color carries a strong and well-established regulatory standing in both the United States and Canada.

In the U.S., Caramel Color is affirmed GRAS under 21 CFR 182.1235² and does not require color certification under 21 CFR 73.85.³ In Canada, all four classes of caramel color are permitted under Health Canada's List of Permitted Colouring Agents (List 3)⁴ and approved for use across a wide range of food categories.

One regulatory consideration specific to the U.S. is California's Proposition 65, which requires labeling for 4-methylimidazole (4-Mel) — a byproduct of cooking a carbohydrate with a nitrogen source. 4-Mel is present in Class III and IV Caramel Colors, as well as in other food products. Labeling is required when exposure thresholds exceed 29 mcg/day in the final product.⁵ To help manufacturers manage this, Sethness Roquette has developed low 4-Mel Caramel Color options to reduce 4-Mel levels in finished products and mitigate Prop 65 risk when that is a concern.

Beyond the U.S. and Canada, regulatory requirements vary by region. Standards in Europe, Mexico, South America, Asia-Pacific, and the Middle East are each governed by the applicable regional frameworks.

Sethness Roquette recommends that customers consult their regulatory affairs and legal teams to confirm current requirements before finalizing formulations or label claims.

A Practical Reformulation Approach

Based on Sethness Roquette's experience supporting reformulation projects across a wide range of food and beverage categories, a structured evaluation process consistently produces better outcomes than trial-and-error benchwork. The following approach is recommended:

- **Step 1 Define the system:** Document your food system's pH, protein load, fat content, processing conditions (heat exposure, shear, hold times) and labeling requirements (non-GMO, organic, etc.). This profile drives class and product selection.

² [eCFR :: 21 CFR 182.1235 -- Caramel.](#)

³ [eCFR :: 21 CFR 73.85 -- Caramel.](#)

⁴ [3. List of Permitted Food Colours \(Lists of Permitted Food Additives\) - Canada.ca](#)

⁵ [The Proposition 65 List - OEHHA](#)

- **Step 2 Establish the hue target:** Define acceptable color range using colorimetric measurement. This gives you an objective benchmark and reduces subjectivity in bench evaluation.
- **Step 3 Select the class and color:** Use the system profile and hue target to narrow to one or three Caramel Colors, based on class selections. Run a charge compatibility screen before full bench work.
- **Step 4 Optimize dosage and form:** Titrate Caramel Color concentration to hue target. Evaluate both liquid and powder forms if process compatibility allows.
- **Step 5 Validate stability:** Run accelerated shelf-life and light stability testing on the reformulated product before commercial scale-up.

Sethness Roquette's technical team is available throughout this process from initial system evaluation through to scale-up support. We maintain application-specific expertise across beverage, bakery, savory, confectionery, and dairy categories.

Conclusion

Reformulating away from FD&C colors is achievable and, depending on the color target and application, Caramel Color can deliver a commercially viable result. The keys are selecting the right class, setting accurate hue expectations, and building a structured evaluation process rather than treating it as a simple ingredient swap.

Manufacturers who navigate this transition most successfully tend to work with a color supplier that brings genuine technical depth — from bench-scale development through commercial production — and the consistency to deliver against a validated specification.

Sethness Roquette has been that partner for over 145 years, and we welcome the opportunity to support your reformulation work.

Contact Us

To discuss your specific application or request a technical consultation, reach out to your account manager, through our [website](#), or at: mail@sethness-roquette.com.