



Food Additives Overview

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FD&C Blue #1 Overview

FD&C Blue #1 is an FDA approved blue food coloring for the categories: confections, beverages, cereals, frozen dairy desserts, popsicles, frostings, and icings. FD&C Blue #1 is also known as Brilliant Blue FCF. The chemical name for Brilliant Blue FCF is Disodium 3-[N-ethyl-N-[4-[[4-[N-ethyl-N-(3- sulfonatobenzyl)-amino] phenyl] (2-sulfonatophenyl) methylene]-2,5-cyclohexadiene -1-ylidene] ammoniomethyl] benzenesulfonate. FD&C Blue #1 must be 85% colorant material, soluble in water and slightly soluble in ethanol.

Regulatory Status

- [The FDA lists FD&C Blue #1](#) as approved for use in food as a coloring agent. [A statement released on 04/22/25](#) from the FDA and HHS announced the intention to phase out Blue #1 from the US food supply by the end of 2026.
- [EFSA's re-evaluation of Brilliant Blue FCF \(E 133\) as a food additive](#) looked at scientific studies to revise the ADA to 6 mg/kg body weight/day from 10 mg/kg body weight/day.
- [GSFA Online Food Additive Details for Brilliant Blue FCF](#) is a list of max levels for Brilliant Blue for different categories as established by CODEX.
- In Canada, Brilliant Blue has been approved as a food colorant with allowable concentration based upon the food group category in the [List of Permitted Colouring Agents](#).
- In Australia and New Zealand, Brilliant Blue is on the [list of added colors available in Australia](#) allowing for its use in food.
- [JECFA has released a specification for Brilliant Blue FCF](#).

Scientific Studies

- [Re-evaluation of Brilliant Blue FCF \(E 133\) as a food additive](#) supported a revision to the ADI on Brilliant Blue to 6 mg/kg bw/day from 10 mg/kg bw/day.
- [JECFA re-evaluated](#) a max ADI to 6 mg/kg body weight/day by looking at a long term toxicity study in rats but established that most current usage is generally below this threshold.

Alternatives

FD&C Blue #2 is a more indigo color than FD&C Blue #1 but could be used to get a different blue color. Spirulina is an additional replacement for FD&C Blue #1. Butterfly pea flower extract can also be a replacement for FD&C Blue #1.

Additional Reading

- [Adding Molecules to Food, Pros and Cons: A Review on Synthetic and Natural Food Additives - 2014 - Comprehensive Reviews in Food Science and Food Safety](#)



FD&C Blue #2 Overview

FD&C Blue #2 also known as Indigo Carmine or Indigotine. The FDA has approved FD&C Blue #2 for baked goods, cereals, snack foods, ice cream, confections and yogurt. FD & C Blue #2 is primarily a disodium salt of 2-(1,3-dihydro-3-oxo-5-sulfo-2H-indol-2-ylidene)-2,3-dihydro-3-oxo-1H-indole-5-sulfonic acid. FD&C Blue #2 was approved for use in the United States in 1987.

Regulatory Status

- [The FDA lists FD&C Blue #2](#) as approved for use in food as a coloring agent. [A statement released on 04/22/25](#) from the FDA and HHS announced the intention to phase out Blue #2 from the US food supply by the end of 2026.
- [EFSA's re-evaluation of Indigo Carmine \(E 132\) as a food additive](#) looked at scientific studies to determine that with a 93% pure coloring and 7% volatile matter purity the Acceptable Daily Intake (ADI) of 5 mg/kg body weight/day was applicable.
- [GSFA Online Food Additive Details for Indigotine \(Indigo carmine\)](#) is a list of max level for Indigotine for different categories as established by CODEX.
- In Canada Indigotine has been approved as a food colorant with allowable concentration based upon the food group category as shown in the [List of Permitted Colouring Agents](#).
- In Australia and New Zealand Indigotine is on [the list of added colors](#) available in Australia allowing for its use in food.
- FD&C Blue #2 has undergone extensive safety reviews. [Toxicological studies](#) conducted by JECFA have determined that to be safe for human consumption within the established ADI levels.

Scientific Studies

- [Scientific Opinion on the re-evaluation of Indigo Carmine \(E 132\) as a food additive](#) looked at Indigo Carmine and determined it was not necessary to change the ADI from 5 mg/kg body weight/day.
- [An FSAZN evaluation](#) looked at the average consumption that Australian and New Zealand individuals have for various synthetic food dyes as well as the ADIs of these dyes. The conclusion was that there is not concern with the current Indigotine consumption.

Alternatives

FD&C Blue #1 is a brighter blue color than FD&C Blue #2 but could be used to get a brighter blue color. Spirulina is an additional replacement for FD&C Blue #2. Butterfly pea flower extract can also be a replacement for FD&C Blue #2.

Additional Reading

- [Adding Molecules to Food, Pros and Cons: A Review on Synthetic and Natural Food Additives - 2014 - Comprehensive Reviews in Food Science and Food Safety](#)





FD&C Green #3 Overview

FD&C Green #3, or Fast Green FCF, is approved by the FDA for use in food, drugs and cosmetics. FD&C Green #3 was approved for use by the FDA in 1982 for foods in general. FD&C Green #3 is soluble in water with some solubility in ethanol. [FD&C Green #3](#) must be at least 85% coloring material with the principal components of non-coloring material sodium chloride, sodium sulfate, and water.

Regulatory Status

- [The FDA lists FD&C Green #3](#) as approved for use in food as a coloring agent. [A statement released on 04/22/25](#) from the FDA and HHS announced the intention to phase out Green #3 from the US food supply by the end of 2026.
- Fast Green FCF is not a permitted food color additive as [determined by EFSA](#).
- CODEX sets global food standards and regulations, using [JECFA's evaluations to inform on Fast Green FCF](#).
- In Canada Fast Green FCF has been approved in 100 ppm. singly or in combination in accordance with the [List of Permitted Colouring Agents](#).
- Australia has an allowable ADI of up to 25 mg/kg bw/day for [Fast Green FCF](#).

Scientific Studies

- [California's Food Dyes Health Effects Assessment](#) found that synthetic food dyes may cause or exacerbate neurobehavioral problems in some children.
- [The FAO/WHO concluded that](#) dietary exposures for adolescents and all other age groups do not present a health concern.

Alternatives

Chlorophyll is a natural replacement for FD&C Green #3. Matcha and spinach powders can also be used to color foods green, but they will also add flavor. Spirulina extract can also be a natural alternative.

Additional Reading

- [The Application of Computer Color Matching Techniques to the Matching of Target Colors in a Food Substrate: A First Step in the Development of Foods with Customized Appearance - 2022 - Journal of Food Science](#)
- [On the manipulation, and meaning\(s\), of color in food: A historical perspective - 2022 - Journal of Food Science](#)



FD&C Red #3 Overview

FD&C Red #3 is a color additive that imparts a cherry red color. In Canada and Europe FD&C Red #3 often can be found under the name erythrosine. FD&C Red #3 is used in several food categories, particularly candied fruits, confectionary decorations, and processed meats. Erythrosine has poor absorption into the human body with consumption at levels of allowed usage. It should be noted that in the US, Red #40, an alternative for erythrosine, is the predominant synthetic food coloring being used and there are also many natural color alternates in use.

Regulatory Status

- In the EU, the European Food Safety Commission (EFSA) permits [erythrosine \(E127\) for candied cherries and pet foods as well as in pharmacological products](#).
- [Health Canada limits erythrosine usage to 100 – 300 ppm](#), dependent upon the food category.
- [Australia limits erythrosine usage to cherries, candies and confectionary toppings](#).
- Under the Delaney Clause, the [FDA does not allow the use of Red No. 3 in food products](#) after January 15, 2027.
- [Codex Alimentarius limits usage, depending upon the food category, to 30 – 200 mg/kg in products](#). The Codex categories include processed meats, fermented vegetable products, confectionary decorations, toppings, sweet sauces, chewing gum, and candied fruits.

Scientific Studies

- While there has been academic interest in possible connections of erythrosine consumption and ADHD, the [EFSA scientific opinion on erythrosine](#) noted there is no evidence to support erythrosine penetrating the blood brain barrier to give rise to significant brain concentrations, which would be necessary to produce hyperactivity through the proposed mechanisms.
- The Joint FAO/WHO Expert Committee on Food Additives (JECFA), which is part of Codex, [evaluated dietary exposure for children](#) and concluded that dietary exposures to erythrosine for all age groups did not present a health concern.

Alternatives

- Synthetic: Red No. 40
- Natural: Betacyanins, anthocyanins, carmine

Additional Reading

- [Coloring Foods & Beverages - IFT.org](#)
- [Agro-waste: A potential source of natural colorants | Ingredients | Science Meets Food](#)





FD&C Red #40 Overview

FD&C Red #40 also known as Allura Red AC or disodium 2-hydroxy-1-(2-methoxy-5-methyl-4-sulphonatophenylazo) naphthalene-6-sulphonate is used as a red food coloring. FD&C Red #40 is an azo dye. Allura Red AC was developed in 1971 by Allied Chemical Corporation to be used as a red food coloring. The purity of Allura Red AC is at least 85%. Red #40 is often used in human food in candies, cereals, beverages, snacks, ice cream, and even baked goods.

Regulatory Status

- [The FDA lists FD&C Red #40](#) as approved for use in food as a coloring agent. [A statement released on 04/22/25](#) from the FDA and HHS announced the intention to phase out Red #40 from the US food supply by the end of 2026.
- Allura Red AC is allowable by EFSA as a food colorant with an ADI of 7 mg/kg body weight/day as determined in the [Re-evaluation of Allura Red AC \(E 129\) as a food additive](#).
- [GSFA Online Food Additive Details for Allura Red AC](#) is a list of max levels for Allura Red AC for different categories as established by CODEX.
- In Canada Allura Red AC has been approved in 300 ppm singly or in combination in accordance with section B.06.002 as shown in the [List of Permitted Colouring Agents](#).
- In Australia and New Zealand Allura Red AC is on the [list of added colors](#) available in Australia allowing for its use in food.
- [JECFA has released a specification for Allura Red AC](#).

Scientific Studies

- [Re-evaluation of Allura Red AC \(E 129\) as a food additive](#) did not conclude a revision is necessary to the ADI of 7 mg/kg body weight/day.
- [Safety Evaluation of Certain Food Additives](#) reviews scientific studies that have been completed concerning Allura Red AC as well as the foods that it is used in and dietary exposure and established an ADI of 10 mg/kg body weight/day.
- [A Food Standards Australia New Zealand \(FSANZ\) evaluation](#) determined that there is not concern with the current Allura Red AC consumption.

Alternatives

There are a variety of potential replacements depending on the application. Anthocyanins such as elderberry or black carrot might be good alternatives though there might be additional concerns with these colors' dependent on the product's pH. Carmine or cochineal could also be used though these are derived from specific scale insects. Beet juice or beetroot can be another popular and economical alternative to FD&C Red #40. Other alternatives also include spices such as annatto and paprika extract.

Additional Reading

- [Radish Anthocyanin Extract as a Natural Red Colorant for Maraschino Cherries - 1996 - Journal of Food Science](#)





FD&C Yellow #5 Overview

FD&C Yellow #5, also known as Tartrazine, is a trisodium salt. In the United States Yellow #5 was approved for use by the FDA in 1969 and must be called out as [FD&C Yellow #5](#) on the ingredient panel. FD&C Yellow #5 is used as a coloring agent in food and not less than 85% of FD&C Yellow #5 must be coloring matters. FD&C Yellow #5 is soluble in water. Yellow #5 is an azo dye, which gives it a vibrant yellow color. FD&C Yellow #5 is one of nine approved color additives that is allowed in the following products: confections, cereals, snack foods, beverages, condiments, baked goods and yogurt.

Regulatory Status

- [The FDA lists FD&C Yellow #5](#) as approved for use in food as a coloring agent. [A statement released on 04/22/25](#) from the FDA and HHS announced the intention to phase out Yellow #5 from the US food supply by the end of 2026.
- Tartrazine is allowable as a food colorant with an Acceptable Daily Intake (ADI) of 7.5 mg/kg bw/day by an EFSA [Re-evaluation of Tartrazine \(E 102\) as a food additive](#).
- CODEX Alimentarius has published [recommendations for tartrazine in various food categories](#).
- In Canada Tartrazine has been approved in 300 ppm singly or in combination in accordance with section B.06.002 in the [List of Permitted Colouring Agents](#).
- Australia has an allowable ADI of 7.5 mg/kg bw/day for tartrazine as discussed in the [Toxicity of tartrazine: Scientific review report](#).
- JECFA has set the ADI for FD&C Yellow #5 at the same [7.5 mg/kg body weight per day](#).

Scientific Studies

- [Re-evaluation of Tartrazine \(E 102\) as a food additive](#) did not revise the ADI of 7.5 mg/kg body weight/day.
- [Toxicity of tartrazine: Scientific review report](#) looks at the average consumption that Australian and New Zealand individuals have for various synthetic food dyes as well as the ADIs of these dyes. The conclusion was that there is not concern with the current Tartrazine consumption.

Alternatives

FD&C Yellow #6 could be used but will have a more orange color. Natural replacements may include annatto extract, beta-carotene, or spices like turmeric or saffron.

Additional Reading

- [The Application of Computer Color Matching Techniques to the Matching of Target Colors in a Food Substrate: A First Step in the Development of Foods with Customized Appearance - 2012 - Journal of Food Science](#)
- [Effect of Food Azo Dye Tartrazine on Learning and Memory Functions in Mice and Rats, and the Possible Mechanisms Involved - 2011 - Journal of Food Science](#)





FD&C Yellow #6 Overview

FD&C Yellow #6, also known as Sunset Yellow FCF, is an orange-yellow food coloring. Sunset Yellow FCF is primarily 6-hydroxy-5-[(4-sulfophenyl)azo]-2-naphthalenesulfonic acid. Sunset Yellow FCF was approved in the United States in 1969 and is approved for use in most foods in accordance with good manufacturing practice.

Regulatory Status

- [The FDA lists FD&C Yellow #6](#) as approved for use in food as a coloring agent. [A statement released on 04/22/25](#) from the FDA and HHS announced the intention to phase out Yellow #6 from the US food supply by the end of 2026.
- [EFSA's re-evaluation of Sunset Yellow FCF \(E 110\) as a food additive](#) looked at scientific studies to reduce the ADI for two years pending additional data to 1 mg/kg bw/day from 2.5 mg/kg body weight/day.
- [GSFA Online Food Additive Details for Sunset Yellow FCF](#) is a list of max levels for Sunset Yellow for different categories as established by CODEX.
- In Canada Sunset Yellow FCF has been approved in 300 ppm singly or in combination in accordance with section B.06.002 for most foods as shown in [List of Permitted Colouring Agents](#).
- In Australia and New Zealand Sunset Yellow FCF is on the [list of added colors available in Australia](#) allowing for its use in food.
- [JECFA released a specification for Sunset Yellow FCF](#).

Scientific Studies

- [Re-evaluation of Sunset Yellow FCF \(E 110\) as a food additive](#) reduced the ADI from 2.5 mg/kg bw/day to 1 mg/kg bw/day temporarily for two years as more data is gathered and evaluated.
- [A FSANZ evaluation](#) looked at the average consumption that Australian and New Zealand individuals have for various synthetic food dyes as well as the ADIs of these dyes. The conclusion was that there is not concern with the current Sunset Yellow FCF consumption.

Alternatives

Some options to replace Sunset Yellow FCF are turmeric, safflower concentrate, carotenoids, annatto, lutein, and annatto.

Additional Reading

- [Risk assessment of azo dyes as food additives: Revision and discussion of data gaps toward their improvement - 2022 - Comprehensive Reviews in Food Science and Food Safety](#)
- [All India Survey for Analyses of Colors in Sweets and Savories: Exposure Risk in Indian Population - 2013 - Journal of Food Science](#)





Azodicarbonamide Overview

[Azodicarbonamide \(ADA\)](#) is a chemical substance used as a whitening agent in cereal flour and as a dough conditioner in bread baking. ADA helps make bread products fluffier and more visually appealing. Concern over ADA, also known as diazenedicarboxamide, stems from the breakdown of ADA during bread making that produces semicarbazide (SEM). The concern around SEM stems from studies showing female mice that consume large amounts of SEM have increased incidence of tumors, though this is not the case in male mice or rats of either gender. Azodicarbonamide can also be used in food grade plastics where it is a blowing agent.

Regulatory Status

- [The FDA has approved use of azodicarbonamide](#) as a whitening agent in flour and a dough conditioner in quantities not to exceed 45 ppm.
- Azodicarbonamide is not permitted for use as a dough conditioner, flour whitening agent or in food grade plastics as [EFSA publishes further evaluation on semicarbazide in food](#).
- [GSFA Online Food Additive Details for Azodicarbonamide](#) is a list of max levels for Azodicarbonamide for different categories as established by CODEX.
- In Canada Azodicarbonamide is permitted as a food additive as noted in the [List of Permitted Bleaching, Maturing or Dough Conditioning Agents](#) and can also be present in food contact plastics.
- Australia does not recognize azodicarbonamide as an approved [food additive](#).
- [JECFA has released a specification for Azodicarbonamide](#).

Scientific Studies

- A [2001 health assessment](#) conducted by the Organisation for Economic Co-operation and Development (OECD) concluded that evaluation of carcinogenicity was not possible on the basis of the available data.
- A [1999 study](#) by the WHO determined that there wasn't enough data that relating to carcinogenic, reproductive, or developmental effects to evaluate the risk to human health.
- [An assessment](#) by the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) found that due to the limited information available, the chemical is not considered to be carcinogenic.

Alternatives

There are a few alternatives to azodicarbonamide as a dough conditioner and whitener including ascorbic acid, potassium iodate, and calcium peroxide.

Additional Reading

- [Application of Visible/Near-Infrared Spectroscopy in the Prediction of Azodicarbonamide in Wheat Flour - 2017 - Journal of Food Science](#)





Potassium Bromate Overview

Potassium bromate (KBrO₃) is an oxidizing agent that has been used in [bread making since 1916](#). As an oxidizing agent, it speeds up breadmaking, and is converted to bromide, which primarily evaporates. It has also been used to increase the rate of the malting process for barley, where it is depleted through the process. It is considered a processing aid in both breadmaking and malting applications. Over the years, many major manufacturers have removed potassium bromate and have moved to [enzyme and other alternatives](#).

Regulatory Status

- Potassium bromate has been used as a bread dough conditioner since 1916, as permitted by the FDA's standards of identity for flour used for various types of bread, rolls, and buns.
- The [Joint FAO/WHO Expert Committee on Food Additives \(JECFA\)](#), part of Codex, removed approval of potassium bromate in 1995. Improved testing methodologies detected residual bromate in products, this finding, coupled with previous studies on the toxicity/carcinogenicity of potassium bromate, resulted in the removed approval.
- The EU and [Canada](#) have bans on potassium bromate.
- [Japan allows potassium bromate](#) in a breadmaking process designed to completely remove it to the lowest detectable limit (LDL).

Scientific Studies

- [A 2023 paper studied the use of potassium bromate in baked goods in Cameroon](#) and found residual concentrations over 10-200x the US limits. The study concluded that at the excessive residue levels found, the likelihood of early onset cancer caused by continued consumption of the breads significantly increased and requested new regulations be applied.
- [Bromide intoxication at high levels](#) (0.5-1.0 grams) can cause neuro-psychiatric changes in mammals, including humans, that are dose dependent.

Alternatives

Ascorbic acid, azodicarbonamide, potassium and calcium iodate, cysteine and glutathione are potential alternatives to potassium bromate.

Additional Reading

- [Looking Back to Look Forward: A Review of FDA's Food Additives Safety Assessment and Recommendations for Modernizing its Program - Maffini - 2013 - Comprehensive Reviews in Food Science and Food Safety - Wiley Online Library](#)





Titanium Dioxide (TiO₂) Overview

Titanium dioxide (TiO₂) has been used in foods as a whitening agent and food colorant for over 100 years in food categories from breads and confections to beverages. Recent safety concerns have risen around nanoparticles of TiO₂. These concerns have led to additional research and safety analyses from regulatory bodies around the world.

Regulatory Status

- [The US Food and Drug Administration \(FDA\) allows for restricted use](#), where the maximum use is 1% by weight of a food, but only to the good manufacturing practice level necessary to impart the needed effect.
- Titanium dioxide is [currently banned by the European Food Safety Authority \(EFSA\)](#), with [ongoing legal discourse](#).
- The Joint FAO/WHO Expert Committee on Food Additives (JECFA), which is part of Codex, determined TiO₂ was inert and safe to use in 1961. JECFA repeated assessments in 1969 and 2012 confirming their original assessment. [WHO has initiated further review](#) due to the EFSA ban in 2023.
- Authorities in [Canada, Australia and New Zealand](#) all maintain TiO₂ is safe for good manufacturing practice use in 2022-2023.

Scientific Studies

- The [EFSA review](#) concluded the following:
 - Studies on general and organ toxicity did not indicate adverse effects up to a dose of 1,000 mg/kg body weight per day.
 - No effects were seen in studies retrieved from the literature with TiO₂ nanoparticles >30 nm up to the highest dose tested of 100 mg/kg body weight per day.
 - No effects were noted on reproductive and developmental toxicity up to a dose of 1,000mg/kg body weight per day.
- The Japanese National Institute of Health Sciences [published a study](#) in 2023 finding no effects from TiO₂ after repeated oral administration of crystallite size of 6 nm at up to 1000mg/kg body weight/day.

Alternatives

While there is no single substitute for all current uses of TiO₂, there are some alternatives for specific uses. Potential alternatives include rice flour, rice starch and corn starch.

Additional Reading

- [Absorption, Distribution and Excretion of Four Forms of Titanium Dioxide Pigment in the Rat - Farrell - 2017 - Journal of Food Science](#)
- [Identification of Nanoscale Ingredients in Commercial Food Products... Athinarayanan - 2015 - Journal of Food Science](#)





BHA/BHT Overview

Butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are used as antioxidants. Both BHA and BHT delay rancidity in food by delaying oxidative reactions. BHA and BHT are frequently used in cereals, chips, baking mixes and other foods to help delay oxidation of fats, which leads to rancidity.

Regulatory Status

- In the US, BHA and BHT are [generally recognized as safe \(GRAS\) per the Food and Drug Administration \(FDA\)](#) for use in food when the total of antioxidants is not greater than 0.02% of fat or oil content.
- The [FAO/WHO expert committee on food additives \(JECFA\)](#), evaluated BHA in 1989 and established an acceptable daily intake (ADI) of 0.5mg/kg body weight/day. In 2012, [JECFA reevaluated BHT](#) with two 2-generational rat studies and updated the ADI to 0.05 mg/kg body weight/day.
- In 2011 the [European Food Safety Authority \(EFSA\)](#) re-evaluated BHA and re-established the ADI at 1 mg/kg body weight/day. In 2012 [EFSA re-evaluated BHT](#) and re-established the ADI at 0.25mg/kg body weight/day.

Scientific Studies

- In 2000, analysis from the [Netherlands Cohort Study](#) found no increased risk of stomach cancer within men and women at normal dietary intake levels of BHA.
- The National Cancer Institute (NCI) conducted a [study on BHT](#) with mice and rats by feeding various levels of BHT within food. Even at the higher levels the study concluded that the BHT was not carcinogenic.
- [A study published in 2021](#) found BHA prevents tumor necrosis factor (TNF) cytotoxicity, acting as a RIPK1 inhibitor.

Alternatives

While limited, potential alternatives include tocopherols and rosemary extract.

Additional Reading

- [2,6-Di-Tert-Butyl-Hydroxytoluene and Its Metabolites in Foods - Nieva-Echevarría - 2015 - Comprehensive Reviews in Food Science and Food Safety](#)
- [Natural Antioxidants: Sources, Compounds, Mechanisms of Action, and Potential Applications - Brewer - 2011 - Comprehensive Reviews in Food Science and Food Safety](#)
- [Natural Additives in Wheat-Based Pasta and Noodle Products: Opportunities for Enhanced Nutritional and Functional Properties - Li - 2014 - Comprehensive Reviews in Food Science and Food Safety](#)



Propylparaben Overview

Propylparaben is an anti-microbial preservative primarily used in bakery and beverage products. While it is synthetically made, it is a natural compound found in plants and insects. Propylparaben may also be used in its sodium salt form, sodium propyl p-hydroxybenzoate. Originally approved for use in foods in the 1960's, in the 2000's updated reviews have resulted in removal of approval by some regulatory bodies.

Regulatory Status

- The [US Food and Drug Administration \(FDA\)](#) permits propylparaben at a maximum level of 0.1% in foods.
- [Health Canada](#) allows limited use of propylparaben in specific foods.
- The European Food Safety Authority (EFSA) approved propylparaben for use in 1994 then later [revoked approval in 2004](#).
- [Australia and New Zealand](#) allow propylparaben to a maximum permissible level (MPL) of 2500mg/kg.
- Evaluated by the [Joint FAO/WHO Expert Committee on Food Additives as part of Codex \(JECFA\)](#) starting in 1962, it was originally allowed as a food additive by Codex in 1974 with an allowable daily intake (ADI) of 10 mg/kg body weight/day. In 2006, JECFA reviewed new research and concluded that due to adverse effects indicated in the reproductive systems of rats at 10mg/kg body weight/day, approval should be withdrawn.

Scientific Studies

- In 2004 the [European Food Safety Authority \(EFSA\) and Commission Scientific Committee for Food \(SCF\)](#) were unable to recommend an acceptable daily intake (ADI) of propylparaben in a joint assessment. While they believed there was unlikely to be any immediate or long-term health danger from propylparaben at the current use level, they recommended removing approval of propylparaben.
- [Health Canada undertook evaluations of propylparaben](#) in 2019 concluding:
 - Evidence indicates that propylparaben is not likely to be genotoxic in vivo (EFSA 1994; Andersen 2008).
 - Considering the totality of evidence, a no observed adverse effect level (NOAEL) of 1000mg/kg body weight/day, (based on findings from Sivaraman et al. 2008), was selected.

Alternatives

There are [other antimicrobial preservatives](#) that can be used such as chlorobutanol, methylparaben, phenoxyethanol and others.

Additional Reading

- [Inactivation of foodborne pathogens by the synergistic combinations of food processing technologies and food-grade compounds - Zhang - 2020 - Comprehensive Reviews in Food Science and Food Safety](#)
- [Looking Back to Look Forward: A Review of FDA's Food Additives Safety Assessment and Recommendations for Modernizing its Program - Maffini](#)



Bromated Vegetable Oil (BVO) Overview

Bromated Vegetable Oil (BVO) was used since 1931 in the beverage industry as a stabilizing emulsifier for oil-based flavors (e.g., citrus flavor) to prevent the flavor from separating from the beverage. BVO does this by balancing the oil flavor molecular weight close to that of water. BVO averages 8-10 ppm in most products where used. Many [major manufacturers](#) have removed BVO from their mainline beverages over the past 10 years.

Regulatory Status

- BVO use is currently allowed in Canada at up to 15 ppm. In May 2024, [Health Canada proposed to remove BVO from the list of permitted food additives](#).
- [The FDA revoked regulation allowing the use of BVO in food in July 2024](#), with the rule effective August 2024 and compliance mandatory one year after the effective date.
- BVO is banned from use as a food additive in the [EU](#) & [Japan](#).
- BVO is [not included as an approved additive](#) in Australia and New Zealand.

Scientific Studies

- A [study published in 2022](#) confirmed oral exposure to BVO is associated with increased buildup of bromine in tissues with the potential for thyroid toxicity.
- The FDA and the National Institute of Environmental Health Sciences' Division of Translational Toxicology observed adverse health effects in animal studies with exposure to BVO. For this reason the ["FDA can no longer conclude that this use of BVO in food is safe."](#)

Alternatives

Sucrose acetate isobutyrate is the primary replacement for brominated vegetable oil.

Additional Reading

- [Best Practices for Chemical Hazards - IFT.org](#)
- [Quest for Clean Labels Causes Murky Legal Actions - IFT.org](#)





Partially Hydrogenated Oils (PHOs) Overview

Partially hydrogenated oils (PHOs) are manufactured through a hydrogenation process converting liquid vegetable oil to a solid at room temperature. Partially hydrogenated oils became widely used in certain segments of the food industry due to their resistance to rancidity and ability to withstand heating multiple times. Partially hydrogenated oils contain on average anywhere from 25% to 45% trans fats. The trans fats that occur as a result of the hydrogenation are a concern when it comes to LDL (bad) cholesterol and coronary heart disease.

Regulatory Status

- [The FDA Final Determination Regarding Partially Hydrogenated Oils \(Removing Trans Fat\)](#) determined in 2015 that partially hydrogenated oils are no longer Generally Recognized as Safe (GRAS) with all products containing partially hydrogenated oils to no longer be manufactured by 1/1/2020 for non-petitioned uses of partially hydrogenated oils and 1/1/2021 for petitioned uses of partially hydrogenated oils.
- [EU passed a new regulation on trans fats](#) in 2019 stating that no more than 2g of industrially produced trans fats per 100g (about the weight of a deck of playing cards) of fat in food is allowable in foods with a compliance date of 04/02/2021.
- CODEX does not have specific standards for PHOs; [however, they do offer guidance on trans fatty acids in the food supply](#).
- [The Canadian Ban on partially hydrogenated oils](#) banned the manufacture of items with partially hydrogenated oils beginning on 09/17/2018 with an additional two years for products manufactured before this date to be sold.
- [Australia has not created a policy around partially hydrogenated oils within foods](#).
- The WHO has recommended the ban of partially hydrogenated oils due to [trans fat concerns with partially hydrogenated oils](#) and in 2018, the WHO launched a global initiative called REPLACE to eliminate industrial trans fats from the global food supply by 2023.

Scientific Studies

- [The WHO developed a global laboratory protocol for measuring trans fat in foods](#). This also looks at ways to eliminate or replace PHOs within the foods they are found in.

Alternatives

The replacement for PHO will depend on the application it is being substituted in. Some common replacements are coconut oil, palm oil, lard, butter, and high oleic oils. Fully hydrogenated oils do not contain trans fats.

Additional Reading

- [Trans fatty acids in food: A review on dietary intake, health impact, regulations and alternatives - 2021 - Journal of Food Science](#)





Bisphenol A Overview (BPA) Overview

2,2-bis(4-hydroxyphenyl) or Bisphenol A (BPA) is approved for use in food contact material in the manufacturing of certain plastics and resins or in protective coatings for containers such as water bottles, baby bottles, and the lining of food cans. Originating in the 1960s, BPA has been used in food packaging for its ability to harden plastics, making them durable and resistant to damage. Recent studies have shown that minute amounts of BPA can leach from the packaging into the contents it holds.

Regulatory Status

- The [US Food and Drug Administration \(FDA\) has concluded a No Observed Adverse Effect Level \(NOAEL\)](#) of 5 mg/kg body weight/day. BPA is currently prohibited in baby bottles and sippy cups and its use in infant formula packaging has been phased out.
- [EFSA's re-evaluation of BPA](#) in 2023 dropped the tolerable daily intake (TDI) dropped from 4 micrograms/kg body weight/day to the current level of .2ng/kg body weight/day. The EU has banned BPA in baby bottles and restricted its use in other food contact materials.
- CODEX does not have specific standards solely for Bisphenol A.
- Health Canada is [monitoring Canadian exposure to BPA](#) and protecting newborns and infants. Canada has restrictions on its use in products for infants and children, including baby bottles.
- Australia conducted a survey in 2016 regarding the amount of BPA within food. It was concluded that the exposure to Australians is within acceptable safe limits. Australia has issued a [voluntary phase out of BPA use](#) in polycarbonate baby bottles.
- In a [joint FAO/WHO expert meeting](#) the controversy around BPA was acknowledged but the conclusion was that there is not sufficient evidence from applicable studies to establish a "safe" level.

Scientific Studies

- [The German Federal Institute for Risk Assessment \(BfR\) completed a study](#) to determine a Tolerable Daily Intake (TDI) of BPA to be .2 µg/kg body weight/day.
- [The FDA released a review](#) of literature and data and no new end points were identified. The result was that the studies satisfying the risk assessment criteria supported the current NOAEL. There is a study currently under way on chronic toxicity.

Alternatives

While there is no single substitute for all current uses of Bisphenol A there is work being done on potential alternatives based on use. The Government of Canada has provided a [comprehensive list of potential alternatives](#). Some manufacturers are using alternatives such as BPS (Bisphenol S) and BPF (Bisphenol F), though BPS and BPF have raised their own health concerns.

Additional Reading

- [Are Canned Beverages Industries Progressively Switching to Bisphenol AF? - 2019 - Journal of Food Science](#)
- [Memorandum Letter: Final report for the review of literature and data on BPA - 2024 - FDA](#)



FASTFOOD
PACKAGING

WATER RESISTANT
CLOTHING

STAIN
RESISTANT

PERSONAL CARE

NON-STICK
COOKWARE

PHOTOGRAPHY

PFAS Overview

PFAS are per- and polyfluoroalkyl substances that are a group of thousands of man-made substances that all have a carbon-fluorine bond. This bond is very strong and does not degrade easily. PFAS chemicals resist grease, oil, water, and heat, making them useful in many applications including food packaging. PFAS first came into use in the 1950s. PFAS have been used for widespread purposes and for this reason is accumulating in the water and soil of some areas. It is now understood that there is bioaccumulation of certain PFAS chemicals and some PFAS chemicals have been associated with health impacts. PFAS are persistent in the environment and the human body, earning them the title of “forever chemicals.”

Regulatory Status

- [The FDA has authorized specific PFAS for use in food contact applications.](#) Starting in February of 2024 grease-proofing substances with PFAS for food contact use are no longer permitted for sale.
- [EFSA set a tolerable weekly intake \(TWI\)](#) of 4.4 nanograms per kilogram of body weight.
- Canada, with some exceptions, [has prohibited the manufacture, use, sale and import of:](#) perfluorooctanoic acid (PFOA), its salts, and precursors, perfluorooctane sulfonate (PFOS), its salts, and precursors and long-chain perfluorocarboxylic acids (LC-PFCAs), their salts, and precursors. Canada has also published a [state of PFAS report.](#)
- The FAO/WHO Codex Committee on Contaminants in Food (CCCF) did include PFAS on a [list of substances to be evaluated by JECFA.](#) The JECFA is scheduled to conduct safety assessments of PFAS in the coming years.
- The Australian Packaging Covenant Organisation (APCO) set [an action plan](#) to phase out PFAS in fibre-based food contact packaging by the end of 2023.

Scientific Studies

- [Safer Alternatives to PFAS in Food Packaging](#) identified six chemicals that were determined to be less hazardous than PFAS and one that was determined to be more hazardous than PFAS.
- [Potential health effects of PFAS chemicals](#) covered ongoing research in to the mechanisms of PFAS toxicity from exposure to individual factors. Additional testing is recommended to draw conclusions.

Alternatives

There are many alternatives available, and more being researched. Waxes and silicone could be a good substitute for PFAS depending on the application. Film laminates, such as those of polyethylene are common but can pose a challenge with recycling and composting. Interest in biodegradable polymers such as polylactic acid is increasing as is interest in barriers composed of starch, cellulose, and chitosan. The effectiveness of these alternatives will vary by the product and its needs.

Additional Reading

- [Per- and polyfluoroalkyl substances and their alternatives in paper food packaging \(wiley.com\) - 2021 - Comprehensive Reviews in Food Science and Food Safety](#)
- [Best Practices for Chemical Hazards - 2024 - Food Technology magazine](#)



Phthalates Overview

Phthalates are commonly used in polyvinyl chloride (PVC) as a plasticizer to reduce brittleness in consumer products, including food packaging. Phthalates are not approved to be added directly to foods. Phthalates can also be used as components of adhesives, lubricants, and sealants. They can also migrate into food or from contact with plastic containers during food processing.

Regulatory Status

- [The FDA has approved nine ortho-phthalates](#) for use in food packaging and minor areas of food contact. On May 19, 2022, the FDA issued a request for information on the eight phthalates being used as plasticizers for information such as use levels and dietary exposure.
- [Phthalates and other plasticizers are priorities for reassessment](#) for EFSA. At the request of the European Commission EFSA is beginning preparatory work to re-evaluate the health risks. [EFSA updated their risk assessment for five substances](#) in 2019 to establish a tolerable daily intake (TDI) of 50 µg/kg body weight per day for DBP, BBP, DEHP and DINP. DIDP was given a TDI of 150 µg/kg body weight per day.
- CODEX does not have specific standards solely for phthalates in food or food contact materials.
- [Health Canada groups phthalates into 14 substances](#). Of the group of 14 phthalates, DEHP was the only substance concluded to be harmful to human health and there is a proposal currently to use the Prohibition of Certain Toxic Substances Regulations to ban DEHP.
- [Australia conducted a survey in 2018](#) regarding the exposure Australians have to seven plasticizers, five of which are phthalates. The survey indicated that the levels Australians are consuming these at do not pose a health risk.

Scientific Studies

- The government of Canada is [continuing to monitor](#) the exposure of Canadians to Di(2-ethylhexyl) phthalate which has been decreasing.
- [Guidelines for Drinking-water Quality](#) looks at two studies and determined that DEHA is not a health concern since it occurs at concentrations well below health concerns, DEHP was recommended to limit exposure to the lowest level attainable, and Dimethoate was given a guidance ADI of .002 mg/kg body weight.

Alternatives

There are a large number of chemicals that could be used as plasticizers including benzoates, terephthalates, citrates and many more including some biobased alternatives. There is also work being done on bonded plasticizers that would be considered “non-migratory.” Some current replacements are Hexamoll DINCH, Acetyl tributyl citrate (ATBC), trioctyl trimellitate (TOTM), epoxidised soybean oil (ESBO), and many more.

Additional Reading

- [Migration regularity of phthalates in polyethylene wrap film of food packaging - 2020 - Journal of Food Science](#)
- [Endocrine modulating chemicals in food packaging: A review of phthalates and bisphenols - 2023 - Comprehensive Reviews in Food Science and Food Safety](#)



The IFT Mission:

Connecting global food system communities to promote and advance the science of food and its application.

The IFT Vision:

A world where science and innovation are connected and universally accepted as essential to improving food for everyone.

