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## Artificial Chemicals in Food: Additives in Modern Food 84

By [leahlefler](#)

A dizzying array of chemical compounds is used in [modern food](#). Artificially manufactured dyes, preservatives, flavors, texture enhancers, and fats enhance the way food looks, tastes, and feels. Considerable debate has raged over the long-term safety of chemical food additives, which are regulated by the Food and Drug Administration (FDA) in the United States. The FDA allows the addition of non-nutritive substances as long as the chemical is "generally recognized as safe (GRAS)." Certain additives have been banned over time, as the toxic nature of the chemical became known.

### Regulation of Food Additives: A Brief History

Prior to the formation of the FDA, artificial additives to food were not regulated. Borax was used in many foods as a preservative, and lead salts were used to give cheese a bright orange color. Sulfuric acid was dumped into beer to decrease the brewing time. Since refrigeration was difficult to obtain in the early 20<sup>th</sup> century, formaldehyde (embalming fluid) was added to milk to prevent curdling.

Butchers sold rotten meat, disguising it by using a mixture of boric acid, salt, and a red dye from the cochineal beetle: the putrid meat would appear fresh enough for purchase by an unwitting consumer. It isn't surprising that more than a few food scandals erupted: Russel Alger (the Secretary of War under William McKinley) was [forced to resign](#) after formaldehyde laden beef was fed to U.S. troops during the Spanish American War. The troops became so ill they could not fight.

### The Poison Squad: Testing Chemicals in Food

Congress finally granted \$5,000 to study the effects of various food additives on people. Dr. Harvey Wiley, the head of the Bureau of Chemistry (part of the USDA, which later became the FDA) spearheaded the study, using a group of twelve brave volunteers known as the "Poison Squad." These men were fed common food additives of the day (borax, salicylic acid, sulfuric acid, sodium benzoate, and formaldehyde) in controlled doses, mixed into their food. The volunteers consumed the additives in gelatin capsules (not knowing which capsule contained an additive or was a placebo), and were subjected to medical examinations each week. The men consumed the additives for a period of five years, and agreed not to sue the researchers for any ill effects obtained during the study.



Harvey Wiley (left) conducted experiments to determine the safety of certain food additives. These experiments later led to the formation of the Food and Drug Administration (FDA).  
Source: [Image Courtesy of Wikimedia Commons](#)

The publicity garnered by Wiley's experiments (and the resultant health problems in the volunteers) helped to launch the Pure Food and Drug Act of 1906: borax, copper sulfate, formaldehyde, and salicylic acid (aspirin) were banned as food additives due to their toxic nature. The law was expanded in 1938 to become the Federal Food, Drug, and Cosmetic Act. Additives could not be added to food unless they were found to be safe, and chemicals could not be added to food to mask ingredients that were unfit for human consumption.

Laws regulating food purity and safety are not always followed. In 1992, the grocery chain Food Lion was infiltrated by ABC news. In an undercover exposé, Food Lion employees were shown to re-wrap and re-label meat which had passed the expiry date. Rotten meat was also rinsed in bleach to remove the putrid stench prior to sale. In response, Food Lion sued ABC for fraud, claiming they had misrepresented themselves as employees. The lawsuit also alleged trespassing, since the news reporters came into the Food Lion plant without permission. The grocery chain was awarded \$5 million in damages, though a later appeal to the U.S. Court of Appeals (Fourth Circuit in Richmond, Virginia) overturned the verdict.

### Chemicals in Food: Preservatives

**BHA:** Butylated Hydroxyanisole (BHA) is a white or yellow waxy solid, and is added to food as an anti-oxidant. BHA is fat-soluble, and reacts with oxygen in a preferential manner over the food it is added to, preventing spoilage in fatty foods.

### Why Sodium Bisulfite Was Banned on Fresh Produce

Sodium Bisulfite is an anti-oxidant, and is banned by the Food and Drug Administration for use on fresh



## Common Artificial Flavors

| Chemical Name:               | Flavor:            | Used In:                  |
|------------------------------|--------------------|---------------------------|
| Allyl Hexanoate              | pineapple          | Gummy candy, drinks       |
| Benzaldehyde                 | bitter almond      | Imitation almond extract  |
| Cinnamonic Aldehyde          | Cinnamon           | Chewing gum, candy        |
| Diacetyl                     | Butter             | Microwaveable Popcorn     |
| Ethyl (E,Z)-2,4-decadienoate | Pear               | Pear tea, pear cider      |
| Ethyl Maltol                 | Sugar/Cotton Candy | English toffee, candy     |
| Ethyl Vanillin               | Vanilla            | Imitation vanilla extract |
| Ethyl Propionate             | Fruity             | Chewing gum, candy        |
| Isoamyl Acetate              | Banana             | Banana cakes, candy       |
| Limonene                     | Orange             | Candy                     |
| Methyl Anthranilate          | Grape              | Candy, grape drinks       |
| Methyl Salicylate            | Wintergreen        | Chewing gum, mints        |

## Chemicals in Food: Dyes

Of all the artificial food additives, artificial color serves the least amount of purpose. It does not preserve food or enhance flavor in any way. Artificial color in food simply makes food more enticing to eat - without artificial color, hot dogs would be gray. Farmed salmon has a pink dye added to make the filets red. Everything from children's vitamins to candy ("Taste the Rainbow!") have artificial color.

Many artificial food dyes are manufactured from coal tar or petroleum products. Blue No. 1, for example, is manufactured from coal tar and can be found in some dairy products and in sweets. This dye has been banned in the European Union, but is acceptable in the United States. Red No. 3 is another dye manufactured from coal tar, and is often used in cherries.

Yellow No. 5 (tartrazine) has been subjected to many studies which link artificial coloring agents to Attention Deficit Hyperactivity Disorder. [A 1996 study in the Journal of Nutritional & Environmental Medicine \(Journal of Nutritional & Environmental Medicine \(1997\) 7, 333±342\)](#) demonstrated increased activity levels and aggression in children with ADHD who consumed beverages laced with tartrazine and sunset yellow (Yellow No. 6). Beverages laced with amaranth (a red dye, currently delisted by the FDA because of suspected carcinogenic properties) did not show an increase in hyperactivity.

Several food dyes have been delisted, including Orange No. 2 (previously used to color Florida oranges) and FD&C Violet No. 1. Orange No. 2 was delisted after animal toxicity studies showed the dye was, indeed, toxic. Violet No. 1 was delisted in 1973 after it was found to produce cancer in rats.

### Delisted Dyes: A Brief Synopsis

FD&C Red No. 1 was delisted in 1960 because it caused liver damage in dogs, rats, and mice.

FD&C Red No. 4 was delisted in 1965 after laboratory studies demonstrated damage to the adrenal cortex and urinary bladder in dogs. The chemical was still allowed for use in maraschino cherries until 1976.

FD&C Green No. 1 and FD&C Green No. 2 were delisted in 1966: the dyes were not necessarily harmful to health, but were simply unnecessary (green dye can be made by mixing tartrazine with a blue dye).

FD&C Violet No. 1 was delisted in 1973 due to suspected carcinogenic properties (studies showed the dye produced cancer in lab rats).

Carbon Black was delisted in 1975 because of carcinogens released during the manufacturing process. The artificial colorant is still allowed in Canada.

FD&C Red No. 2 was delisted in 1976 after studies showed it was a carcinogen in rats. Studies performed in Russia also demonstrated the dye was an embryotoxin.



High levels of tartrazine (Yellow No. 5) are used to give Inca Kola (a common carbonated beverage in Peru) its characteristic yellow color. Source: [Image Courtesy of Wikimedia Commons](#)

## List of Artificial Colors Used in Foods

- FD&C Blue No. 1, Brilliant Blue, FCF, E133
- FD&C Blue No. 2, Indigotine, E132
- FD&C Green No. 3, Fast Green, FCF, E143
- FD&C Red No. 40, Allura Red AC, E129
- FD&C Red No. 3, Erythrosine, E127
- FD&C Yellow No. 5, Tartrazine, E102
- FD&C Yellow No. 6, Sunset Yellow FCF, E110

### LIMITED DYES

**Orange B:** Used only in hot dog and sausage casings

**Citrus Red 2:** Only for coloring orange peels

Graphite was delisted in 1977. Graphite contains aromatic hydrocarbons, which are known carcinogens.

### Chemicals in Food: Texture Enhancers

Potassium Bromate is added to flour to create a high-rising bread dough with a springy texture. When added in extremely small amounts (15-30 parts per million), the bromate is "used up" in the baking process, leaving no residual chemical in the bread. If it is used in higher quantities, or if the bread is not cooked at the right temperature, potassium bromate will remain in the finished product. Potassium bromate has been shown to induce tumor formation in rats. The FDA has not banned the additive, but has suggested that bakers stop using the chemical on a voluntary basis.

Potassium bromate has been banned in the United Kingdom and Canada. Since the state of California lists bromate as a carcinogen, bread products must be labeled with a cancer warning if they contain potassium bromate. For this reason, nearly all bread products sold in California are bromate-free.

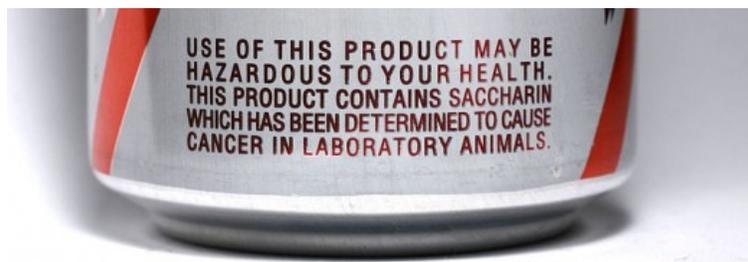
### Chemicals in Food: Fat Substitutes

Olestra was developed by Proctor and Gamble, and approved by the FDA in 1996. The chemical had the same general properties of natural fats: it provided a rich taste and mouthfeel, but passed through the digestive system without being absorbed. Olestra is a synthetic chemical manufactured from sucrose (table sugar), and is able to bind to a number of fatty acids. The resultant molecule is extremely large, and cannot be absorbed in the intestines – because of this property, it adds no calories or nutrition to food.

Unfortunately, the side effects of Olestra caused many people to stop purchasing the product. The chemical additive caused intestinal cramping and diarrhea, and would also bind any natural Vitamin E, Vitamin D, and Vitamin K consumed during the meal. The chemical is banned in the United Kingdom and Canada.

Due to a large drop-off in sales, Proctor and Gamble is now marketing Olestra as a lubricant for industrial use and as an additive for paint. The chemical has been renamed "Sefose" for this purpose.

### The Skinny on Artificial Sweeteners



Warning labels (such as this one, on a diet Dr. Pepper can) were once required for the use of saccharin. The use of warning labels has since been discontinued, as the chemical is not a human carcinogen.

Source: Image Courtesy of Wikimedia Commons

### Chemicals in Food: Artificial Sweeteners

**Aspartame:** Aspartame has come under a great deal of scrutiny, as a widely circulating "chain mail" style of email claimed the artificial sweetener caused diseases ranging from Multiple Sclerosis to Alzheimer's Disease. The original email is ascribed to a "Nancy Markle," though the name is likely fictitious. A very similar health scare rumor letter was penned in 1995 under a different screen name. While chemical additives to food are controversial, there has [been no evidence that aspartame has caused the great diversity of medical problems stated in the email chain letter.](#)

Aspartame is dangerous to those suffering from phenylketonuria (PKU), and anyone who has this genetic disease should avoid the consumption of Aspartame.

Aspartame is a non-saccharide sweetener, made from aspartic acid/phenylalanine dipeptide. The sweetener was subjected to a medical review in 2007, and found to be safe. Of all the artificial sweeteners on the market, aspartame is the most studied and tested on the market. While some critics maintain the FDA is biased in its studies, the entirely independent Government Accountability Office (GAO) found the FDA's rulings to be accurate and the study methods to be properly conducted.

**Acesulfame-K:** Discovered in 1967, most people are unaware that this artificial sweetener exists. With a chemical structure similar to saccharin, the acesulfame-K (K is the chemical symbol for potassium) is stable through heating processes and is calorie-free. The product is added to chewing gum, sugar-free Jell-O, and some "Lite" chocolate syrups. Approved by the FDA in 1988, the sweetener has been studied many times and has not shown any carcinogenic effect. Acesulfame-K is allowed in the United States and in the European Union.

**Saccharin:** The only sweetener to have carried an active warning label, saccharin demonstrated an increase in bladder cancer rates among male laboratory rats. The artificial sweetener was added to the U.S. National Toxicology Program's "Report on Carcinogens" in 1981. The increase in bladder cancer could never be demonstrated in a human population, and further studies determined the increase in bladder cancer rates were due to a unique mechanism found in male rats. While saccharin *is* a carcinogen for rats, it will not increase bladder cancer rates in humans. The chemical was delisted from the "Report on Carcinogens" on December 21, 2000. The warning labels were taken off the product, as the danger did not apply to human consumers.