Food Coloring

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If we look around us, we see color. Colors allow us to become familiar and sometimes identify certain objects. We can look at the sky and associate the gray clouds with possible rain. We also can tell by the change in the color of leaves that fall is right around the corner. Color also can be applied to foods because it is very important to capture the desired aesthetic quality of that particular food. For example, orange flavored sherbet is more appealing if it is orange rather than white. For this reason, food coloring has become important in food industries.

There are two types of food colors: natural versus "certified" food colors. Natural colors are pigments obtained from animals, vegetables, or mineral sources that are not required to be certified for chemical purity by the FDA. Some examples are carotenoids, anthocyanins, and chlorophyll. Synthetic color additives are considered "certified" because specifications and restrictions are described in Title 21 of the Code of Federal Regulations. There are two types of certified color additives: FD&C Dyes and FD&C Lake. Dyes are water soluble and exhibit their colors when dissolved in solvent. Lakes are insoluble pigments that color by dispersion. It is made by placing an aluminum or calcium salt of an FD&C dye on an alumina base. Both types of colors are used, but natural color extracts have neither the intensity nor the stability of certified colors; they often fade and change over time.

One popular food coloring used by industries in the U.S. is FD&C Yellow No. 5. This food coloring dye, also known as tartrazine, is a man-made color that has been around since 1916. It provides a distinctive lemon-yellow color when applied to food. It is used to color ice cream, candy, beverages, custards, and many other foods. FD&C Yellow No. 5 is analyzed by both the manufacturer and the Food and Drug Administration (FDA), and it has been confirmed to be safe. The FDA established an acceptable daily intake (ADI) for tartrazine to be 5.0 milligrams per kilogram of body weight per day. This is equivalent to about 300 mg (approximately .01 oz) per day for a 60-kg (132-pound) person.

Although tartrazine is widely used in foods, it has been associated with a variety of allergic type reactions in sensitive people. Because of these allergic reactions, in 1979 the FDA required the presence of FD&C Yellow No. 5 to be labeled on foods and drugs. The U.S. Department of Agriculture also requires labeling of meat and poultry products containing FD&C Yellow No. 5. It has been reported (Miller, 1982) that between 10 to 40 percent of aspirin-sensitive patients may react to tartrazine. But a separate study done by Stevenson et al. (1984) failed to show any positive responses to the previous study.

Another popular man-made food colorant dye is FD&C Red No. 3, also known as erythrosine.
Erythrosine has provided a distinctive watermelon-red color to foods such as dairy products, cherries, vegetable products, jams, jellies, after having been approved in the U.S. since 1907. Because erythrosine also is used in drugs and cosmetics, it has been widely studied, with numerous experiments conducted on rats, hamsters, dogs, and swine. The majority of the studies did not prove to show any carcinogenic or genotoxic effects of the color. But one, known as the IRDC study (1982), found adverse effects involved in utero exposure in rats at four dose levels up to 4.0 percent. Thyroid tumors were observed at a higher ratio in male rats that received the 4.0 percent level, but none were seen at the lower dose levels of 0.1 percent, 0.5 percent, or 1.0 percent. Although this may seem to be a concerning matter, studies done on humans failed to identify adverse effects following the ingestion of FD&C Red No. 3 (Anderson et al., 1964; Berstein et al., 1975; Bora et al., 1969). But even with this in mind, it is recommended that the maximum daily intake for FD&C Red No. 3 is 24 mg/kg. This figure may seem too small an amount for an entire day, but a longitudinal study done for a period of 2 years found that 99 percent of the 12,000 people sampled were estimated to have intakes equal to or below the value as indicated.

FD&C Yellow No. 6 is an azo food dye that has been used since 1929. It gives a reddish-yellow color to foods and drugs. It is used only in small amounts because of its high tinctorial strength—a little goes a long way. The maximum daily intake established by the FDA is 225 mg (about .008 oz) per day for a 60-kg (132-lb) person. There have been several isolated cases of reports involving allergic-type reactions to FD&C Yellow No. 6. However, the FDA stated that while an allergic-type response may occasionally occur, there is no information to suggest that the color is hazardous to the rest of the population. Even studies done on animals have not confirmed an association between FD&C Yellow No. 6 and allergic reaction. Studies conducted for carcinogenicity showed to be negative, which permitted the dye to become permanently listed in the U.S.

FD&C Blue No. 1, or Brilliant Blue FCF, is a triphenylmethane color. Triphenylmethane consists of three aromatic rings that is attached to a central carbon atom. This dye is water soluble and is poorly absorbed by the body, which means that more than 90 percent will be recovered in the feces unchanged, making it readily usable in most foods. The Average Daily Intake (ADI) reported by the National Academy of Science is 16 mg. An analysis of intakes in the United Kingdom showed that the average intake is at least 5,000 times less than the ADI. Many studies have been conducted on FD&C Blue No. 1, and it has shown no evidence of carcinogenicity and no adverse effects other than 15 percent less body weight. Also, no adverse reproductive or developmental effects have been exhibited. The FDA has concluded the FD&C Blue No. 1 to be safe.

FD&C Red No. 2 or Amaranth is the most controversial of the color additives used here in the United States. It had been used in foods since 1908 but is now banned from use. In 1970, two Russian studies alleged that Amaranth was both carcinogenic and embryotoxic. Although there were many questions concerning the validity of the Russian data, the FDA conducted its own study and confirmed their results. Other studies tried to dispute the findings, but due to unresolved questions about its safety, Amaranth was removed from use in food in 1976. Dispite United States stance on Amaranth, it is still the most widely used red colorant in the world.

Although some individuals raise questions about the purpose of food coloring, it has been noted that only ten percent of the food in the United States contains added color. So why are colors used in foods?

- To offset color loss due to exposure to air, light, varying temperatures, moisture, and storage conditions.

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To provide a colorful identity to foods that would otherwise be virtually colorless, such as ice cream.
- To correct natural variations in color.
- To protect flavors and vitamins that may be affected during storage and by acting as a light filter.
- To provide an appealing variety of wholesome and nutritious foods that meet consumers' demands.

### Certified Color Additives Listed for Use in Foods as of January 1986

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<th>Provisional</th>
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<tr>
<td>FD&amp;C Red No. 3</td>
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### National Academy of Science 1977 Survey of Amount of Certified FD&C Colorants Consumed

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<tr>
<th>Colorant</th>
<th>Avg. Daily Intake (mg)</th>
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<td>FD&amp;C Red No. 40</td>
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### References


Food Color Facts. Internation Food Information Council.

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