

**REVIEW ARTICLE**

## A Review on Food Coloring Agents – Safe or Unsafe?

P Shanmugasundaram<sup>1\*</sup>, Bavenro<sup>2</sup>, T Rujaswini<sup>3</sup>

<sup>1</sup>School of Pharmaceutical Sciences, Vels Institute of Science Technology and Advanced Studies (VISTAS), Chennai, India.

<sup>2</sup>Department of Pharmaceutical Chemistry and Analysis, School of Pharmaceutical Sciences, Vels Institute of Science Technology and Advanced Studies (VISTAS), Chennai, India.

<sup>3</sup>Department of Pharmacy Practice, School of Pharmaceutical Sciences, Vels Institute of Science Technology and Advanced Studies (VISTAS), Chennai, India.

\*Corresponding Author E-mail: [samsimahe@gmail.com](mailto:samsimahe@gmail.com)

### ABSTRACT:

Food coloring agents are added to foods to make customer perception. They act as emulsifying agents, stabilizers, sweeteners, antioxidants, preservatives and so on. They also increase attractiveness to different types of products. Coloring of the food product not only gives pleasant, attractive color but also flavor, natural value of the product. Food coloring is a solution of dye molecules. Natural food coloring agents are carotenoids, chlorophyll, anthocyanin, and turmeric. Few dyes may have carcinogenic effects so suitable detection methods are to be done to check the harmfulness of the dye. Appropriateness of a dye is checked through several analytical and advanced methods. The aim of this article is to bring to a notice whether food coloring agents are harmful to human use. Not all types of coloring agents are harmful to use in foods, drugs and cosmetics. Artificial food colors are used mainly in foods and beverages. Food and Drug Association (FDA) approval is required for the use of artificial food colors. Few artificial colorants used in foods, cosmetics, beverages are sunset yellow, quinoline yellow, carmoisine, allura red and tartrazine. These coloring agents bind to Human Serum Albumin (HAS) and causes risk to human health. Artificial food coloring agents cause attention deficit hyperactivity disorder (ADHD) in children. We conclude that natural coloring agents don't show any side effects when compared to artificial dyes.

**KEYWORDS:** Food coloring agents, emulsifying agents, Food and Drug Association, attention deficit hyperactivity disorder, Human Serum Albumin.

### INTRODUCTION:

The first factor of attraction of food is its color. Non nutritious substances added intentionally or unintentionally, little amount to food, cosmetics, etc., which improves their appearance, taste, texture and storage properties are known to be food additives<sup>(1)</sup>.

A few food additives act as preservatives which has antimicrobial and antioxidant activity<sup>(2)</sup>. Food additives can be sweeteners, coloring agents, preservatives, emulsifying agents, stabilizers, etc. Food dyes are used in pickles, medications, cosmetics, drinks, etc. Children are at a greater rate of consumption of artificially food dye products. Often, natural food coloring agents was preferred by food manufacturing companies to avoid any adverse actions. Few add dyes illegally to food products which are known to raise carcinogenic as well as genotoxic effects<sup>(3)</sup>.

For all the products containing with dyes inspections are done by Good manufacturing practice (GMP) members and approval is required for marketing as to avoid serious side effects on human<sup>(4)</sup>. As dyes give more colorful and attractiveness, to the products they were in

use for many years. Always safety and potentiality of the dyes used to be monitored to avoid health issues. To ensure that all the products with coloring agents are safe to use federal authorities should check, monitor and regulate and certify them to the market.

Few natural food coloring agents are carotenoids, chlorophyll, anthocyanin, and turmeric<sup>(5)</sup>. As they are nontoxic in nature the natural coloring agents are used in textiles, drugs, food products and also in cosmetics.

Artificial food dyes approved by the US Food and Drug Administration (FDA) and the European Food Safety Authority (EFSA) is as follows:

1. **Erythrosine (Red No. 3):** A pink color dye mostly used in sugar coated products such as candies, lollipops etc.
2. **Allura Red (Red No. 40):** A dark red colored dye widely used in the foods and drugs which we consume on a daily basis, such as cereal bars, sports drinks, bakery, meat, and sweets products. It also to be labeled on product as an ingredient.
3. **Tartrazine (Yellow No. 5):** It is an organic azo dye which was known as a lemon-yellow dye that is noted in foods such as sweet coated products, soft drinks, chips, popcorn and also in drugs and cosmetics.
4. **Sunset Yellow (Yellow No. 5):** It is a petroleum derived azo dye which produces orange-yellow shade to food, drugs and cosmetics when added.
5. **Brilliant Blue (Blue No. 1):** This is water soluble and greenish-blue dye used in food, textiles, leathers, and cosmetics.
6. **Indigotine (Blue No. 2):** This type of dye is used for reddish blue coloring of foods.
7. **Fast green (Green No.3):** It is a Turquoise blue color used in candy, drinks and icing.

The popular food coloring dyes are **Allura Red, Tartrazine** and **Sunset Yellow**<sup>(6)</sup>. Green No.3 was approved by the US, but banned in Europe. Many drugs, foods as well as dyes vary with the country. Few dyes were approved in some countries but banned in other<sup>(7)</sup>.

#### Health effects:

Food additives cause allergic reactions, particularly among those with an aspirin intolerance<sup>(8,9)</sup>. Rashes, swelling of the skin was also noted in few taking artificially dyed products. Hyperactivity changes were noted in children taking artificial colored products and sodium benzoate preservatives in their food products<sup>(10,11)</sup>.

Attention deficit hyperactive disorder (ADHD) in children is noticed with the use of food additives<sup>(12)</sup>. Studies showing that use of 20-40mg of artificial coloring agents has a higher chance of ADHD<sup>(13)</sup>.

Food dyes that showing carcinogenic effects were used illegally to food by a few manufacturers. Irritability, depression and difficulty in sleeping are few behavioral changes noted in people using tartrazine in their food products<sup>(14)</sup>. Asthmatic problem was also noted in few with the use of tartrazine<sup>(15,16)</sup>. In few recent studies blue 2 showing the chances of brain tumor<sup>(17)</sup>.

Various analytical methods such as liquid chromatography-mass chromatography, spectrophotometry, mass spectrometry, etc. are to be done for detection and assure each dye is free from harmful effects<sup>(18)</sup>. Allura red bind to human serum albumin (HAS) which has a potential risk to human. The interaction between allura red and HAS can be determined by fluorescence, UV absorption and circular dichroism<sup>(19)</sup>.

#### DISCUSSION:

Regulatory agencies such as the US Food and Drug Administration (FDA) and the European Food Safety Authority (EFSA), monitors and safeguards human health with the use of dyes, but not everyone obeys to that. Few food dyes are known to be safe in a few countries, but banned in other countries, this is more confusing to assess safety of humanity.

Lucas CD in his study concluded that the use of natural coloring agents has a low risk of raising adverse reactions<sup>(20)</sup>. Amin KA based on his results concluded that tartrazine alter biochemical markers of liver and kidney not only at higher doses but also at low doses<sup>(21)</sup>.

#### CONCLUSION:

Few dyes may cause allergic reactions and hyperactivity actions in children as well as adults, but if those dyes do not any allergic actions, then there is no need of eliminating them from daily use. We don't have any confirming evidence to end up that everyone should be avoided artificial food dyes. All dyes are not dangerous, but few does. Although avoiding foods that contain dyes can improve overall health. However, unhealthy processed foods contain food dyes which act as preservatives to store food for long duration these are found to be health hazards and should be definitely avoided by all at any cost. By the way my suggestion is to take nutritious foods that naturally dyed free.

#### REFERENCE:

1. Sigurdson GT, Tang P, Giusti MM. Natural colorants: food colorants from natural sources. Annual review of food science and technology. 2017 Feb 28; 8:261-80.
2. Siva R, Palackan MG, Maimoon L, Geetha T, Bhakta D, Balamurugan P, Rajanarayanan S. Evaluation of antibacterial, antifungal, and antioxidant properties of some food dyes. Food Science and Biotechnology. 2011 Feb 1; 20(1):7-13.
3. Oplawska-Stachowiak M, Elliott CT. Food colors: Existing and

- emerging food safety concerns. *Critical reviews in food science and nutrition*. 2017 Feb 11; 57(3):524-48.
4. Lehto S, Buchweitz M, Klimm A, Straßburger R, Bechtold C, Ulberth F. Comparison of food colour regulations in the EU and the US: a review of current provisions. *Food Additives and Contaminants: Part A*. 2017 Mar 4; 34(3):335-55.
  5. Rohrig B. Eating with Your Eyes: The Chemistry of Food Colorings. *Issues*. 2015 Oct; 2015:2016.
  6. Potera C. Diet and nutrition: the artificial food dye blues. *Environmental health perspectives*. 2010 Oct; 118(10):A428.
  7. Lehto S, Buchweitz M, Klimm A, Straßburger R, Bechtold C, Ulberth F. Comparison of food colour regulations in the EU and the US: a review of current provisions. *Food Additives and Contaminants: Part A*. 2017 Mar 4; 34(3):335-55.
  8. Vojdani A, Vojdani C. Immune reactivity to food coloring. *ALTERNATIVE THERAPIES*. 2015 Jan 1:148.
  9. STENIUS BS, LEMOLA M. Hypersensitivity to acetylsalicylic acid (ASA) and tartrazine in patients with asthma. *Clinical & Experimental Allergy*. 1976 Mar; 6(2):119-29.
  10. McCann D, Barrett A, Cooper A, Crumpler D, Dalen L, Grimshaw K, Kitchin E, Lok K, Porteous L, Prince E, Sonuga-Barke E. Food additives and hyperactive behaviour in 3-year-old and 8/9-year-old children in the community: a randomised, double-blinded, placebo-controlled trial. *The lancet*. 2007 Nov 3; 370(9598):1560-7.
  11. Schab DW, Trinh NH. Do artificial food colors promote hyperactivity in children with hyperactive syndromes? A meta-analysis of double-blind placebo-controlled trials. *Journal of Developmental and Behavioral Pediatrics*. 2004 Dec 1; 25(6):423-34.
  12. Boris M, Mandel FS. Foods and additives are common causes of the attention deficit hyperactive disorder in children. *Annals of allergy*. 1994 May 1; 72(5):462-7.
  13. Stevens LJ, Kuczek T, Burgess JR, Stochelski MA, Arnold LE, Galland L. Mechanisms of behavioral, atopic, and other reactions to artificial food colors in children. *Nutrition reviews*. 2013 May 1; 71(5):268-81.
  14. Rowe KS, Rowe KJ. Synthetic food coloring and behavior: a dose response effect in a double-blind, placebo-controlled, repeated-measures study. *The journal of pediatrics*. 1994 Nov 1; 125(5):691-8.
  15. Dipalma JR. Tartrazine sensitivity. *American family physician*. 1990 Nov; 42(5):1347-50.
  16. Mikkelsen H, Larsen JC, Tarding F. Hypersensitivity reactions to food colours with special reference to the natural colour annatto extract (butter colour). In *Toxicological aspects of food safety 1978* (pp. 141-143). Springer, Berlin, Heidelberg.
  17. Borzelleca JF, Hogan GK, Koestner A. Chronic toxicity/carcinogenicity study of FD & C Blue No. 2 in rats. *Food and chemical toxicology*. 1985 Jun 1; 23(6):551-8.
  18. Wang L, Zhang G, Wang Y. Binding properties of food colorant allura red with human serum albumin in vitro. *Molecular biology reports*. 2014 May 1; 41(5):3381-91.
  19. Oplatomska-Stachowiak M, Elliott CT. Food colors: Existing and emerging food safety concerns. *Critical reviews in food science and nutrition*. 2017 Feb 11; 57(3):524-48.
  20. Lucas CD, Hallagan JB, Taylor SL. The role of natural color additives in food allergy. *Advances in food and nutrition research*. 2001; 43:195-216.
  21. Amin KA, Hameid II HA, Elsttar AA. Effect of food azo dyes tartrazine and carmoisine on biochemical parameters related to renal, hepatic function and oxidative stress biomarkers in young male rats. *Food and Chemical Toxicology*. 2010 Oct 1; 48(10):2994-9.