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Special Issue on Food Color Toxicity

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IN THIS ISSUE

ABSTRACTS

1. Sunset yellow FCF, a permitted food dye, alters functional responses of splenocytes at non-cytotoxic dose

Sunset yellow FCF (SY) is a permitted food color which is extensively used in various food preparations and quite often exceeds the permissible levels (100-200 mg/kg). Several toxicity studies on SY have been reported earlier, however immunomodulatory properties are yet to be explored. To investigate the immunotoxic properties of SY, splenocytes were isolated, cultured and subjected to mitogen stimulated proliferation assay (lipopolysaccharide, LPS or concanavalin A, Con A), mixed lymphocyte reaction (MLR) assay, immunophenotypic analysis of cell surface receptor expression and assay for cytokines release in the culture supernatants were performed in the presence of SY. Since SY did not exhibit any cytotoxicity up to 250 μg/ml, this dose was used for further studies. It was observed that SY (250 μg/ml) suppressed the mitogen induced proliferation of splenocytes and MLR response. The immunophenotypic analysis revealed that SY alters the relative expression of CD3e/CD4/CD8 in T cells and CD19 in B-cells. Consistent with the suppression of T-cell and B-cell responses and altered surface receptor expression. SY also lowered the expression of IL2, IL4, IL6, IL-17, IFN-γ and TNF-α cytokines. These results suggest that non-cytotoxic dose of SY may have immunomodulatory effects.

Ref: Yadav A, Kumar A, Tripathi A, Das M. Sunset yellow FCF, a permitted food dye, alters functional responses of splenocytes at non-cytotoxic dose. Toxicol Lett. 2013; 217(3):197-204.

2. Toxic effects of some synthetic food colorants and/or flavor additives on male rats.

The purpose was to evaluate the toxic effect of some synthetic additives of colorants and/or flavors present on different body organs and metabolic aspects in rats. A number of chemical food color and flavor additives that are routinely added during processing to improve the aesthetic appearance of the dietary items. However, many of them are toxic after prolonged use. In this work, a total of 100 male albino rats of Spargue Dawley strain were divided into 10 groups: G1 was fed basal diet and served as control, G2: basal diet + Brilliant blue (blue dye, No. 2, 124 mg/kg diet), G3: basal diet + carmoisine (red dye, No. 3, 70 mg/kg diet), G4: basal diet + tartrazine (yellow dye, FD & C yellow No. 5, 75 mg/kg diet), G5: basal diet + trans-anethole (4.5 g/kg diet) G6: basal diet + propylene glycol (0.25 g/kg diet), G7: basal diet + vanillin(1.25 g/kg diet), G8: basal diet + Brilliant blue + propylene glycol, G9: basal diet + carmoisine + trans-anethole, G10: basal diet + tartrazine + vanillin for 42 successive days. All food colorants were mixed with or without flavor additives induced a significant decrease in body weight, hemoglobin concentration and RBC count. There was a significant decrease in reduced glutathione content; glutathione-S-transferase and superoxide dismutase activities in both blood and liver compared to control group. A significant increase in serum alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase activities, bilirubin, urea, creatinine, total protein and albumin were also observed in all test groups when compared to control group. Finally, it is wise to limit the uses of these food colorants and/or food flavor additives especially those used by children.

Ref: El-Wahab HM, Moram GS. Toxic effects of some synthetic food colorants and/or flavor additives on male rats. Toxicol Ind Health. 2013;29(2):224-32.

3. Communicating Food Risks in an Era of Growing Public Distrust: Three Case Studies

In this article, the author examines three U.S.-based food case studies (acrylamide, bisphenol A, and artificial food colorings) where regulations at the local and state levels are increasingly being based on perceived risk advocacy rather than on the most effective response to the risk, be it to food safety or public health, as defined by regulatory interpretation of existing data. Finally, the author sets a series of recommendations for how U.S.-based regulators can best handle those situations where the perceived risk is markedly different from the fact-based risk, such as strengthening the communication departments of food regulatory agencies, training officials in risk communication, and working more proactively with neutral third-party experts.

Ref: Lofstedt R. Communicating food risks in an era of growing public distrust: three case studies. Risk Anal. 2013 Feb;33(2):192-202.

4. Survey On The Use Of Synthetic Food Colors In Food Samples Procured From Different Educational Institutes Of Karachi City

The present study was carried out to find the type of food colors added to various food products especially those found near different educational institutes of Karachi city. Different types of food items were analyzed for isolation and identification of the added synthetic food colors. The majority of branded food items contained permitted colors however some foods manufactured locally contained non-permitted colors. About 11% branded and 44% unbranded food items were found with not permitted colors. Similarly, 4% branded and 30% unbranded beverages were found unfit due to the presence of prohibited colors. Incidences of the use of non-permitted food colors were higher in case of unorganized food makers. A constant observation is needed to ensure that the local manufacturers whether follow the regulations of food colors or not in terms of non-permitted food colors but also about the control and limits of permitted food colors. Moreover, consumption of colored food items should also be controlled by making the society aware of the hazardous effects of food colors.

Ref: Saleem N, Umar ZN, Khan SI. 4. Survey On The Use Of Synthetic Food Colors In Food Samples Procured From Different Educational Institutes Of Karachi City. The Journal Of Tropical Life Science. 2013;3(1),1–7.

5. Comparison of microalgal biomass profiles as novel functional ingredient for food products

Microalgae are one of the most promising sources for new food and functional food products that can be used to enhance the nutritional value of foods due to their well-balanced chemical composition. Knowing their physicochemical characteristics is fundamental for the selection of the most suitable microalgae to specific food technology applications and consequently successful novel foods development. The aim of this study is to screen the chemical composition like proteins, pigments, fatty acids and thermogravimetry properties of five microalgae species like *Chlorella vulgaris* (green and carotenogenic), *Haematococcus pluvialis* (carotenogenic), *Spirulina maxima*, *Diacronema vlkianum* and *Isochrysis galbana* that are used in food industry. *C. green* and *S. maxima* presented high protein (38% and 44%, respectively), low fat content (5% and 4%, respectively). The carotenogenic C. vulgaris and H. pluvialis showed a higher carotenoid content, higher fat, low protein and better resistance to thermal treatment. D. vlkianum and I. galbana presented high protein (38–40%) and fat (18–24%) contents with PUFA's ω3, mainly EPA and DHA. Finally, the results from microalgae chemical and thermal analysis were grouped and correlated through Principal Components Analysis (PCA) in order to determine which variables better define and differentiate them.

Ref: Batista AP, Gouveia L, Bandarra NM, Franco JM, Raymundo A. Comparison of microalgal biomass profiles as novel functional ingredient for food products. Algal Research. 2013;2(2),164–173.

6. Surveillance on Artificial Colors in Different Confectionary Products by Chromatography in Qom.

Food color additives are used to give a perfect look to foodstuff which are very effective in the consumers' satisfaction but they can leave toxic effects on body. With respect to their extensive application, the present research aims to examine the condition of the colorings consumed in confectionary products of the city of Qom. 398 items of confectionary products were sampled randomly and their types of colorings were analyzed through the Thin-Layer Chromatography (TLC) method. Out of which 52 % of the samples were free from coloring, 26.7 % had illegal artificial coloring, and 21.3 contained approved artificial coloring. It was reported that yellow coloring was most consumed. The scientific introduction and replacement of the natural colorings to the Public and emphasis on their advantages play a crucial role in the health of society and can increase enthusiasm of producers and consumers.

Ref: Arast Y, Mohamadian M, Noruzi M,Ramuz Z. Surveillance on Artificial Colors in Different Confectionary Products by Chromatography in Qom. Zahedan Journal of Research in Medical Sciences. 2013;15(3),62-64.

7. Biosynthesis of betalains: yellow and violet plant pigments

Betalains are the yellow and violet pigments that substitute anthocyanins in plants belonging to the order Caryophyllales. These pigments have attracted much attention because of their bioactivities, which range from an antioxidant capacity to the chemoprevention of cancer. However, the biosynthetic pathway of betalains remains under discussion; the main steps have been characterized in recent years, but multiple side reactions are possible. The key enzymes involved have only recently been described, providing clues about the regulation of betalain biosynthesis. In this review, we provide a comprehensive view of the biosynthetic scheme of betalains and discuss the different reactions that have been demonstrated experimentally or proposed in the literature.

Ref: Gandía-Herrero F, García-Carmona F. Biosynthesis of betalains: yellow and violet plant pigments. Trends Plant Sci. 2013;pii: S1360-1385(13)00004-6.

8.Genotoxicity of Synthetic Food Colorants

A study was conducted to evaluate the genotoxicity of the permitted synthetic food colorants used in India. Eight synthetic food colorants namely Erythrosine (E127), Tartrazine (E102), Ponceau 4R (E124), Sunset Yellow FCF (E110), Brilliant Blue FCF (E133), Fast Green FCF (E143), Carmoisine (E122) and Indigo Carmine (E132) and their combination are used in sweets namely Ladu, Jilebi and Halwa in Calicut and suburban areas of Kerala, in India. The genotoxicity of the colorants alone and in combinations at different concentrations were evaluated by Cytokinesis Block Micronucleus (CBMN) Assay. It was observed that all the above colorants and their combinations could cause genotoxicity to human lymphocytes even at the permissible concentration of 100 ppm as per PFA (Prevention of Food Adulteration) Act of India. The toxicity varied from dye to dye and was proportional to their concentration. Combination of colors showed more toxicity than the individual components. Toxicity could be reduced drastically by reducing the concentration of the dyes at least 50% below the permissible limit. Permitted synthetic food colorants even at the permissible limit should be used with caution. This study demonstrated the need for redefining the permissible limit of the food colorants based on Admissible Daily Intake (ADI) as being practiced in developed countries.

Ref: Swaroop VR, Roy DD and Vijayakumar T. Genotoxicity of Synthetic Food Colorants. Journal of Food Science and Engineering. 2011;1,128-134.

9. Genotoxic Effects Of Two Commonly Used Food Additives Of Boric Acid And Sunset Yellow In Root Meristems Of Trigonella Foenum-Graecum

Food additives are the substances that are intentionally added to modify visual appearance, taste, texture, processing or the storage life of food. There has been significant controversy associated with the risks and benefits of food additives. The effect of different concentrations of food additives viz. boric acid and sunset yellow on the chromosomes of Trigonella foenum-graecum L. was investigated. Four concentrations of the two food additives (0.25, 0.50, 0.75 and 1%) were used for 3 hours. All concentrations of boric acid and sunset yellow showed mitoinhibitory effect in root tips of Trigonella foenum-graecum and increase in chromosomal aberrations. Various types of metaphasic and anaphasic aberrations were scored and it was found that metaphasic aberrations were more prominent than the anaphasic aberrations. The most observed aberrations induced by boric acid were stickiness at metaphase, bridges at anaphase, stickiness at anaphase, and scattering at metaphase, while the most prevalent aberrations caused by sunset yellow were precocious movement, unorientation at anaphase, scattering at metaphase and unorientation at metaphase. The result of present study clearly establishes the genotoxic behavior of boric acid and sunset yellow.

Ref: Kumar G, Srivastava N. Genotoxic effects of two commonly used food additives of boric acid and sunset yellow in root Meristems of trigonella foenum-graecum. Iranian Journal of Environmental Health Science & Engineering. 2011;8(4),361-366.

10. Anticancer Effects of Red Beet Pigments

Currently, there is considerable interest in the anticancer effects of red beetroot (Beta vulgaris L.) pigment extract, which is worldwide used as red food color E162 and also used as a natural colorant in cosmetics and drugs. Of particular significance is its broad spectrum of multi-organ antitumor activity demonstrable in laboratory animal models. When this nontoxic plant extract is used in combination with potent anticancer drugs such as doxorubicin (Adriamycin) it acts synergistically and mitigate treatment-related drug toxicity. Betanin, the betacyanin is the main constituent which is primarily responsible for red beet coloration and acts as an antioxidant with an exceptionally high free radical-scavenging activity and is a modulator of oxidative stress. Research focused on anticancer activities of beetroot extract in animal models has unraveled their potential benefits as chemopreventive and chemotherapeutic agents.

Ref: Kapadia GJ, Rao GS. Anticancer Effects of Red Beet Pigments. Red Beet Biotechnology: Food and Pharmaceutical Applications. Springer. 2012;125-154.

11. Toxicology of food dyes

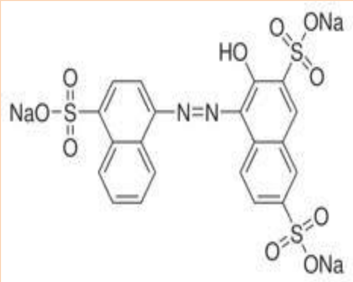
Food dyes that are synthesized originally from coal tar and now petroleum have long been controversial because of safety concerns. Many dyes have been banned because of their adverse effects on laboratory animals or inadequate testing. This review finds that all of the nine currently US-approved dyes raise health concerns of varying degrees. Red 3 causes cancer in animals, and there is evidence that several other dyes also are carcinogenic. Three dyes (Red 40, Yellow 5, and Yellow 6) have been found to be contaminated with benzidine or other carcinogens. At least four dyes (Blue 1, Red 40, Yellow 5, and Yellow 6) cause hypersensitivity reactions. Numerous microbiological and rodent studies of Yellow 5 were positive for genotoxicity. Toxicity tests on two dyes (Citrus Red 2 and Orange B) also suggest safety concerns, but Citrus Red 2 is used at low levels and only on some Florida oranges and Orange B has not been used for several years. The inadequacy of much of the testing and the evidence for carcinogenicity, genotoxicity, and hypersensitivity, coupled with the fact that dyes do not improve the safety or nutritional quality of foods, indicates that all of the currently used dyes should be removed from the food supply and replaced, if at all, by safer colorings. It is recommended that regulatory authorities require better and independent toxicity testing, exercise greater caution regarding continued approval of these dyes, and in the future approve only well-tested, safe dyes.

Ref: Kobylewski S, Jacobson MF. Toxicology of food dyes. Int J Occup Environ Health. 2012;18(3):220-46.

12. Extraction and characterization of some natural plant pigments

Antioxidant activities, total polyphenols and flavonoids, and antimicrobial effects in some plant pigments were determined in order to use these natural materials for cosmetics. The DPPH (1,1-diphenyl-2-picryl hydrazyl radical scavenging activity, % of control at maximum plants extract concentrations of 2500 mg/L) in the thirteen natural plant pigments (black rice, purple sweet potato, yellow bitter melon, yellow paprika, red cabbage, yellow gardenia, blue gardenia, Chinese foxglove, mulberry leave, onion peel, grape peel, mulberry and red beet) ranged from 88.9% for red cabbage to 18.0% for blue gardenia. The highest total polyphenol content (404.2 μg/ml) was measured in the onion peel pigment, and the lowest was in Chinese foxglove pigment (11.4 μg/ml). The red cabbage had the highest total flavonoid amount which was 95.5 μg/ml. The antimicrobial activities of the natural plant pigments were evaluated using the agar diffusion method. Most of the natural pigments for *Bacillus subtilis*, *Micrococcus luteus*, *Escherichia coli*, and *Vibrio parahaemolyticus* showed the clear zone formation of growth inhibition. Purple sweet potato, mulberry, mulberry leaf, grape peel, and blue gardenia showed high antimicrobial activities. These findings suggest that the pigments derived from natural plants had high biological activities, and exhibited different properties depending on each kind of pigments. Therefore these plant resources, having active functional components, can be used as excellent materials for natural cosmetics and food supplements.

Ref: Boo H, Hwang, Bae C, Park S, Heo B, Gorinstein S. Extraction and characterization of some natural plant pigments. Industrial Crops and Products. 2012;40,129–135.



PERMITTED FOOD COLORS:

NAME OF CHEMICAL: AMARANTH

SYNONYMS: Lissamine; Amaranth red; Cranberry Red; Amaranth J; Amaranth R; Azorubine S; FD&C Red No. 2; Amarant [Czech]; Amaranth 85; Acid Red 27.

CASRN: 915-67-3

MOLECULAR FORMULA: $C_{20}H_{11}N_2Na_3O_{10}S_3$

MOLECULAR WEIGHT: 604.47 g/mol

COLOUR: Dark, reddish-brown

PROPERTIES: Melting point : 120 ^{0}C (decomposes); Density: Approximately 1.50; **Solubilities:** Solubility in water=60 mg/ml, in methyl Cellosolve (monomethyl ether of ethylene glycol) = 10 mg/ml, in ethanol = 0.7 mg/ml; Stable to light in aqueous solution.

METHODS OF MANUFACTURING: Derminative procedure for amaranth using high-speed liquid chromatography. fd & c red number 2 were separated by paired-ion chromatography. d & c red number 2 were separated by thin-layer chromatography.

USES: Industrial applications include dyeing leather, staining wood, coloring paper coatings and coloring photographs. Amaranth finds limited use as a biological stain. It can be used as a reagent for the detection of nitrites and nitrates. [1] It is a dark red to purple azo dye once used as a food dye and to color cosmetics, but since 1976 it has been banned in the United States by the Food and Drug

Administration (FDA) as it is a suspected carcinogen. As a food additive it has E number E123.

TOXICITY DATA:

LD50 Intraperitoneal - rat - 1,000 mg/kg. [2]

PERSONAL PROTECTIVE EQUIPMENT:

Avoid contact with skin and eyes. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU). Handle with gloves. Gloves must be inspected prior to use. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands. Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

HANDLING AND STORAGE:

Avoid formation of dust and aerosols. Provide appropriate exhaust ventilation at places where dust is formed. Normal measures for preventive fire protection. Keep container tightly closed in a dry and well-ventilated place.

REFERENCES:

http://toxnet.nlm.nih.gov/cgi-in/sis/search/f?./temp/~nk96vC:1
http://www.chemblink.com/MSDS/MSDSFiles/915-67-3_Sigma-Aldrich.pdf

NAME OF CHEMICAL: FD&C ORANGE NUMBER 1

SYNONYMS: C.I. Acid Orange 20; Acid Orange 20; Tropaeolin 1; Orange S; Aizen Orange I; Acid Orange I; Java Orange I; Orange IM; Eniacid Orange I.

CASRN: 523-44-4

MOLECULAR FORMULA: $C_{16}H_{11}N_2NaO_4S$

MOLECULAR WEIGHT: 350.32 g mol-1

COLOUR: Reddish-brown

PROPERTIES: Solubilities: Generally insol in organic solvents; slightly sol in ethanol, acetone; @ ph 7.6 color is brownish-yellow; 8.9 purple.

METHODS OF MANUFACTURING: Prepd by coupling diazotized sulfanilic acid with alpha-naphthol.

USES: Used for dyeing textiles and leather and as an indicator. FD&C Orange Number 1 was one of the first water soluble dyes to be commercialized, and one of seven original food dyes allowed under the Pure Food and Drug Act of June 30, 1906.

TOXICITY DATA:

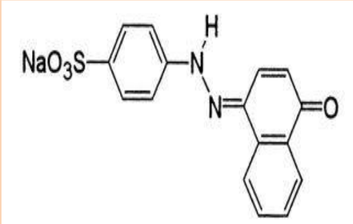
LD50 Intraperitoneal - rat - 1.000 mg/kg. [1] Single doses of 80 mg orange i produced diarrhea (catharsis) in 4-8 hr in several volunteers. [2]

PERSONAL PROTECTIVE EQUIPMENT: Avoid dust formation. Avoid breathing vapors, mist or gas. Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands. Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

HANDLING AND STORAGE: Provide appropriate exhaust ventilation at places where dust is formed.Normal measures for preventive fire. Store in cool place. Keep container tightly closed in a dry and well-ventilated place. protection.

REFERENCES:

http://img1.guidechem.com/msdspdf/523-44-4.pdf
http://toxnet.nlm.nih.gov/cgi-bin/sis/search/f?./temp/~lReTkk:1



NAME OF CHEMICAL: FD&C VIOLET NO. 1

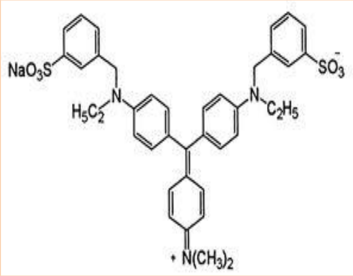
SYNONYMS: Benzyl Violet 4B; Acid Violet 49; FD & C Violet No. 1; Coomassie Violet; Wool Violet; Acid Violet S; Food Violet 2; Violet 2 .

CASRN: 1694-09-3

MOLECULAR FORMULA: C39H40N3NaO6S2

MOLECULAR WEIGHT:

733.871169



PROPERTIES: Solubilities: 25 oz/gallon water @ 70 deg f; 27.5 oz/gallon glycerine; 18.5 oz/gallon propylene glycol; 1/8 oz/gallon 95% alcohol.

METHODS OF MANUFACTURING: Produced commercially by condensing 4-dimethylaminobenzaldehyde with alpha-(n-ethylanilino)-4-toluenesulfonic acid, followed by oxidation & conversion to the sodium salt. Also be prepd by condensing alpha-(n-ethylanilino)-3-toluenesulfonic acid with formaldehyde oxidation in presence of n,n-dimethylaniline. [1]

USES: To color canned dog food /former use/

TOXICITY DATA: Tumorigenic data

Type of test: tdlo - lowest published toxic dose

Route of exposure: oral

Species observed: rodent - rat

Dose/duration: 498 gm/kg/28w-c toxic effects:

Tumorigenic - carcinogenic by rtecs criteria Sense organs and special senses (ear) - effect, not otherwise specified skin and appendages - tumors

Type of test: tdlo - lowest published toxic dose

Route of exposure: subcutaneous

Species observed: rodent - rat

Dose/duration: 9360 mg/kg/2y-I toxic effects :

Tumorigenic - equivocal tumorigenic agent by RTECS criteria

Tumorigenic - tumors at site of application. [2]

PERSONAL PROTECTIVE EQUIPMENT:

Avoid dust formation. Avoid breathing vapors, mist or gas. Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands. Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

HANDLING AND STORAGE: Provide appropriate exhaust ventilation at places where dust is formed.Normal measures for preventive fire. Store in cool place. Keep container tightly closed in a dry and well-ventilated place. protection.

REFERENCES:

http://toxnet.nlm.nih.gov/cgi-bin/sis/search/f?./temp/~N2Hq5X:1
http://img1.guidechem.com/msdspdf/1694-09-3.pdf

NON - PERMITTED FOOD COLORS:
NAME OF CHEMICAL: ALLURA RED

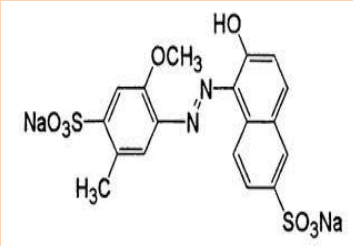
SYNONYMS: Allura Red AC; Food Red No. 40; Curry red; Food red 17; C.I. Food Red 17; Red No. 40; FD and C Red No. 40; CCRIS 3493.

CASRN: 25956-17-6

MOLECULAR FORMULA: C18H14N2Na2O8S2

MOLECULAR WEIGHT: 496,42 g/mol

COLOUR: Dark red



PROPERTIES: Melting Point: >300 deg C; Solubilities: In water, 2.25X10+5 mg/L at 25 deg C, In 50% alcohol, 1.3%, Solubility at 25 deg C: in ethanol, 0.001 g/100 mL; in glycerol, 3.0 g/100 mL; in propylene glycol, 1.5 g/100 Ml. [1]

METHODS OF MANUFACTURING: FD&C Red No. 40 is manufactured by coupling diazotized 5-amino-4-methoxy-2-toluenesulfonic acid with 6-hydroxy-2-naphthalene sulfonic acid.

USES: Color additive in food, drugs, and cosmetics. Used to color gelatins, puddings, custards, alcoholic and nonalcoholic beverages, sauces, topping, candy, sugars, frostings, fruits, juices, dairy products, bakery products, jams, jellies, condiments, meat and poultry. [1]

TOXICITY DATA:

Acute toxicity: LD50 Oral - rat - > 10.100,0 mg/kg. [2]

PERSONAL PROTECTIVE EQUIPMENT: Avoid dust formation. Avoid breathing vapors, mist or gas. Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU). Handle with gloves. Gloves must be inspected prior to use. Respiratory protection is not required.

HANDLING AND STORAGE: Provide appropriate exhaust ventilation at places where dust is formed. Store in cool place. Keep container tightly closed in a dry and well-ventilated place.

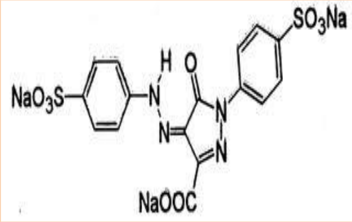
REFERENCES:

http://toxnet.nlm.nih.gov/cgi-bin/sis/search/f?./temp/~Bq7u6q:1
http://img1.guidechem.com/msdspdf/25956-17-6.pdf

NAME OF CHEMICAL: TARTRAZINE
SYNONYMS: Acid yellow 23; Aizen tartrazine; A.F. Yellow No. 4; Tartraphenine; Atul Tartrazine; Erio Tartrazine; Kako Tartrazine; FD&C Yellow No. 5.

CASRN: 1934-21-0

MOLECULAR FORMULA: C16H9N4Na3O9S2



MOLECULAR WEIGHT: 534.3 g/mol

COLOUR: Bright orange-yellow

PROPERTIES: Solubilities: In water, 20.0 g/100 mL at 25 deg C (2.0X10+5 mg/L), In glycerol, 18.0 g/100 mL at 25 deg C; in propylene glycol, 7.0 g/100 mL at 25 deg C, In ethanol, 0.8 mg/mL; in ethylene glycol monomethyl ether, 20 mg/mL, Soluble in concentrated sulfuric acid; Anionic dye; HygroscopicThe aqueous solution is not changed by HCl but becomes redder with sodium hydroxide.

METHODS OF MANUFACTURING: 4-Amino-benzenesulfonic acid is diazotized using hydrochloric acid and sodium nitrite. The diazo compound is coupled with 4,5-dihydro-5-oxo-1-(4-sulfophenyl)-1H-pyrazole-3-carboxylic acid or with the methyl ester, the ethyl ester, or a salt of this carboxylic acid. The resulting dye is purified and isolated as the sodium salt. Formed in a smooth reaction when phenylhydrazine-4-sulfonic acid is heated with dioxosuccinic acid.

USES: For acid yellow 23 (USEPA/OPP Pesticide Code: 110302) ACTIVE products with label matches. /SRP: Registered for use in the U.S. but approved pesticide uses may change periodically and so federal, state and local authorities must be consulted for currently approved uses. As a dye for wool and silks; as colorant in food, drugs and cosmetics. In biochemistry as an adsorption-elution indicator for chloride estimations. Aquatic algaecide/herbicide ingredient. [1]

TOXICITY DATA: Acute toxicity: LD50 Oral - mouse - 12,750 mg/kg;

Toxicity to daphnia and other aquatic invertebrates : EC50 - Daphnia - 5,706.55 mg/l - 48 h . [2]

PERSONAL PROTECTIVE EQUIPMENT: Avoid contact with skin and eyes. Avoid formation of dust and aerosols.Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU). Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Complete suit protecting against chemicals. [3]

HANDLING AND STORAGE: Provide appropriate exhaust ventilation at places where dust is formed. Normal measures for preventive fire protection. Keep container tightly closed in a dry and well-ventilated place.

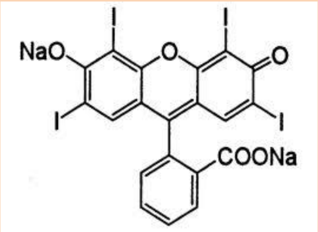
REFERENCES:

http://toxnet.nlm.nih.gov/cgi-bin/sis/search/f?./temp/~MsyQAi:1
http://www.chemblink.com/MSDS/MSDSFiles/1934-21-0_Sigma-Aldrich.pdf
http://img1.guidechem.com/msdspdf/1934-21-0.pdf

NAME OF CHEMICAL: ERYTHROSINE

SYNONYMS: FD&C Red No. 3; TIF Na; FD+C Red No. 3; Pharmakon1600-01505751; NSC36685; NSC-36685; NSC759227; Disodium 2-(2,4,5,7-tetraiodo-6-oxido-3-oxoxanthen-9-yl)benzoate; 9-(o-Carboxyphenyl)-6-hydroxy-2,4,5,7-tetraiodo-3-isoxanthone

CASRN: 16423-68-0



MOLECULAR FORMULA: C20H8I4NaO5+

MOLECULAR WEIGHT: 879.86 g/mol

COLOUR: Brown

PROPERTIES: Solubilities: In water, 9.0 g/100 mL at 25 deg C (9.0X10+4 mg/L), Solubility at 25 deg C: in glycerol, 20.0 g/100 mL; in propylene glycol, 20.0 g/100 mL, Soluble in water to cherry-red solution; soluble in alcohol; Anionic dye; HCl added to an aqueous solution produces a yellowish-brown precipitate; sodium hydroxide produces a red precipitate solution in an excess of the reagent; pH Stability: insoluble at pH 3 and 5; no appreciable changes at pH 7 and 8.

METHODS OF MANUFACTURING: Erythrosine is manufactured by iodination of fluorescein, the condensation product of resorcinol and phthalic anhydride. Tetraiodo derivative of fluorescein and is obtained by treating fluorescein with iodine and iodic acid in alcohol. The dye is isolated as the disodium salt. [1]

USES: For FD&C Red No. 3 (USEPA/OPP Pesticide Code: 120901) there are 0 labels match. /SRP: Not registered for current use in the U.S., but approved pesticide uses may change periodically and so federal, state and local authorities must be consulted for currently approved uses. Biological stain; color additive. [1]

TOXICITY DATA: Acute toxicity: Oral, mouse: LD50 = 1264 mg/kg, Oral, rat: LD50 = 1840 mg/kg. [2]

Toxicity to fish: LC50 - Oryzias latipes - 500 mg/l - 48 h. [3]

PERSONAL PROTECTIVE EQUIPMENT: Use personal protective equipment. Avoid dust formation. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Avoid contact with skin and eyes. Avoid ingestion and inhalation.

HANDLING AND STORAGE: Provide appropriate exhaust ventilation at places where dust is formed. Normal measures for preventive fire protection. Keep container tightly closed in a dry and well-ventilated place. Keep containers tightly closed.

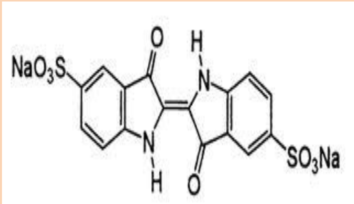
REFERENCES:

http://toxnet.nlm.nih.gov/cgi-bin/sis/search/f?./temp/~QEYIoQ:1
http://www.chemblink.com/MSDS/MSDSFiles/1642368_Fisher%20Scientific.pdf
http://www.chemblink.com/MSDS/MSDSFiles/16423-68-0_Sigma-Aldrich.pdf

NAME OF CHEMICAL: INDIGOTINE

SYNONYMS: FD&C Blue No. 2; BEAG; Acid Blue 74; Indigo-5,5′-disulfonic aciddisodium salt; Acid leather blue IC; Bucacid indigotine B.

CASRN: 860-22-0 .



MOLECULAR FORMULA: C16H8N2Na2O8S2

MOLECULAR WEIGHT: 466.35 g/mol

COLOUR: Purple

PROPERTIES: Melting point : > 300 0C; Solubilities: Slightly soluble in alcohol; practically insoluble in most other organic solvents, Insoluble in benzene, chloroform, In water, 3 mg/mL; Solutions have a blue or bluish-purple color; When heated to decomposition ,emits very toxic fumes of SOx, NOx, and Na2O.

METHODS OF MANUFACTURING: FD&C Blue No. 2 is obtained by heating indigo (or indigo paste) in the presence of sulfuric acid. The color additive is isolated and subjected to purification procedures. The indigo (or indigo paste) used above is manufactured by the fusion of N-phenylglycine (prepared from aniline and formaldehyde) in a molten mixture of sodamide and sodium and potassium hydroxides under ammonia pressure. The indigo is isolated and subjected to purification procedures prior to sulfonation.

USES: Has been used to dye wool directly and silk from either a formic acid or sulfuric acid bath, and that wool and nylon are printed directly; Colorant for nylon, surgical sutures, foods and ingested drugs. As a reagent for functional kidney tests, for detection of nitrates, chlorates and in testing milk. [1]

TOXICITY DATA: Acute toxicity: Oral, mouse: LD50 = 2500 mg/kg; Oral, rat: LD50 = 2 gm/kg. [2]

PERSONAL PROTECTIVE EQUIPMENT: Use personal protective equipment. Avoid dust formation. Avoid breathing dust. Ensure adequate ventilation. Handle with gloves. For prolonged or repeated contact use protective gloves. Choose body protection according to the amount and concentration of the dangerous substance at the work place. Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday. [3]

HANDLING AND STORAGE: Avoid formation of dust and aerosols. Provide appropriate exhaust ventilation at places where dust is formed. Normal measures for preventive fire protection. Keep container tightly closed in a dry and well-ventilated place. Keep in a dry place. Light sensitive. [3]

REFERENCES:

http://toxnet.nlm.nih.gov/cgi-bin/sis/search/f?./temp/~VFXyKg:1
http://www.chemblink.com/MSDS/MSDSFiles/860-22-_Fisher%20Scientific.pdf
http://www.chemblink.com/MSDS/MSDSFiles/860-22-0_Sigma-Aldrich.pdf

NEWS/MEDIA

Food coloring, or color additive, is any dye, pigment or substance that imparts color when it is added to food or drink. They come in many forms consisting of liquids, powders, gels and pastes. Food coloring is used both in commercial food production and in domestic cooking. Due to its safety and general availability, food coloring is also used in a variety of non-food applications including cosmetics, pharmaceuticals, home craft projects and medical devices.

New fear about food dyes-

There aren't many compliments to pay processed food, but even we'll admit: The stuff sure can be colorful. Give the food industry a dull block of ice, and voila.

They'll give you back an azure popsicle. Unfortunately, a blockbuster new study published in the journal Food and Chemical Toxicology finds that blue dye used in edible products might be doing more to our bodies than we thought.

The research team, out of the **Slovak University of Technology,** studied two blue dyes, Patent Blue and Brilliant Blue. The former is banned from food products in the United States, but Brilliant Blue (also known as FD&C Blue No. 1) is used in food, textiles, leathers, and cosmetics in several countries including the U.S.

"[Brilliant Blue] is one of the most commonly used blue dyes," says study co-author **Jarmila Hojerova**, an associate professor at the **Slovak University of Technology** and president of the **Slovak Society of Cosmetology**.

So it must be safe, right? Experts thought so, but **Hojerova** and her colleagues have shown that the dyes can actually enter the bloodstream via the skin or through the digestive tract. That's a major surprise, because it was believed that the skin blocked the dye from seeping into the body, and that ingested dyes were destroyed by the gastrointestinal system.

The team reached their conclusions by studying pig tongues coated with human saliva: Brilliant Blue and Patent Blue dye were placed on the tongues for 20 minutes, in an effort to mimic licking a lollipop. One day later, the team found that both dyes had actually been absorbed through the tongue and into the bloodstream, with Patent Blue penetrating to a greater extent.

The Health Benefits of Reading Food Labels-

The finding is troubling because several studies show that these dyes might inhibit cell respiration, Hojerova says.

"If the process of creating energy and respiration does not take place properly, there are many failures," she notes. Both dyes, for instance, have been linked to ADHD, allergies, and asthma. In 2003, when Brilliant Blue was used as a dye in feeding tubes, the FDA issued a public health advisory because of side effects like blue-tinged skin, urine, and feces, as well as hypotension and death.

In particular, the team found, the blue dyes can seep into the bloodstream when the skin's barrier is impaired, like after shaving, or when the dyes are exposed to the mucous membrane of the tongue. They recommend that the dyes be banned in hard candies and certain cosmetic products to reduce consumer risk. Of course, more research is required to further investigate the blue dye brouhaha. And the International Association of Color Manufacturers, who disagree with the study findings, note in a press release that the amount of dye permeating the skin is negligible when compared to safety limits.

Concerned about synthetic dyes? We don't blame you. Here, three quick tips to cut your exposure:

Choose clean cosmetics-

Ditch the shaving cream, facial cleanser, and anything else containing dye in your medicine cabinet, especially because blue dye can sneak in through damaged skin.

Nosh naturally-

To add some visual zing to your food, reach into your spice cabinet instead of reaching for packaged products. Try bright pink beetroot, yellow turmeric, and golden paprika extract.

Read your labels-

Artificial dyes appear on all kinds of labels, from cosmetics and food to medication. Watch out for these: Blue 1, Blue 2, Citrus Red, Green 3, Orange B, Red 3, Red 40, Yellow 5, and Yellow6.

Food coloring may be linked to ADHD in children

LOS ANGELES (KABC) -- A new study looks into the controversy over food coloring and the association it may have with ADHD in children.The cause of ADHD is still unknown, but some 5.2 million American children have it, and there's a possible link between the disorder and food dyes.

In all, nine different artificial dyes are approved for use in the U.S. Most of the dyes are made from petroleum and their sole purpose is to make food look attractive. New research suggests some food dyes trigger the release of histamines, which are part of the body's immune system. An experiment reported in the American Journal of Psychiatry suggest differences in genes that control histamines might explain why some children are affected and others are not.

"What you really need to know is that these chemicals are in so many different products, whether it's Cheetos or gummy bears or Kool-Aid, so it's very difficult for a child that has a normal American diet to avoid using these types of dyes," said pediatric psychiatry **Dr. Daniel Bober** of Joe DiMaggio Children's Hospital in Florida.

A U.S. Food and Drug Administration advisory committee determined evidence of food dyes causing hyperactivity in kids was inconclusive. But the European parliament demands foods with certain dyes contain warning labels.

What they did say is that there are some children, who if they already have ADHD, that food dyes could exasperate their symptoms," Bober said.

The color industry says the problem is not the dye. They turned down an interview, but an official was quoted as saying, "we don't see any strong compelling data at this point that there is a neurological effect."

Overseeing the safety of artificial food color was one of the reasons the FDA was founded in 1930 and has been the focus of the agency's investigations since the 1950s. The FDA said it needs more research before making any final decisions on the affects.

DID YOU KNOW?

1: **Food coloring is made from petroleum, contaminants, and propylene glycol (a.k.a. antifreeze).**

A little perspective ... Yellow #5 (Tartrazine) is made from crude oil runoff and contains a known carcinogen called benzene. Benzene has been banned from our gasoline in the US. And the same Blue 2 dye that colors our jeans also colors our foods. Now times are tough, but I doubt any of us would eat gasoline or jeans willingly.

2: **Artificial food coloring has been linked to bed-wetting, eczema, mood swings, hyperactivity, sleep disturbances, increased risky behavior, ear infections, headaches, hypersensitivity, obesity, asthma, diabetes, cancer, ADD/ADHD, chromosomal damage, hives, and possibly hypoglycemia.**

Some scientists believe it could play a role in Alzheimer's Disease and Parkinson's Disease.

3: **If a food label includes "artificial color," "artificial color added" or "color added" this means that natural pigments were used.**

Synthetic dyes must be listed on a product, by name (for example Red 40, Yellow 6, Blue 1, Green 3).

EXCEPT:

4: **There are some times when we consume petroleum dyes without ever knowing it:**

In stores: Oranges are sprayed with Citrus Red dye to appear more nutritious, and no label is required. Salmon are given red-colored feed to make their flesh appear brighter (and therefore fresher). Supermarket beef is injected with red dye to hide its otherwise gray hue.

At parties: You knew food coloring was in soda, cake, juices, and candy - but did you know that it's also in those goody bag temporary tattoos, face paints, finger paints, and play dough?

In school cafeterias: Kids consume petroleum food dyes in jelly, yogurt, condiments, meats, juices, fruit cocktail, stuffing, macaroni and cheese, mashed potatoes, chips, pickles, sugar-free and regular pudding, cake, popsicles, ice cream, and flavored milk.

At restaurants: Kids' menu items contain plenty of dyes: Lemonade, sugar-free lemonade, caramel dip, chips, pickles, rice, sauces, condiments, cookies, frozen yogurt, ice cream, "fruit" punch, and juice. Be wary of water taps that do double duty with highly dyed soda. We always bring dye-free, sugar-free drink mix packets.

5: **Synthetic dyes are not vegan due to continual animal testing.**

I found this out after getting the one and only spray tan of my life. If you have a special occasion coming up and want a more natural glow, do an online search for "organic spray tans."

6: **Petroleum dyes are in white liquids and foods, such as coffee creamer and marshmallows.**

7: **Medicines such as pain killers, fever reducers, and allergy treatments (Benadryl) may contain synthetic dyes.**

Ask for dye-free versions of prescriptions from your doctor or pharmacist.

8: **Products with the label "made with organic ingredients" may still contain synthetic dyes.**

Buying 100% certified organic products are an easy way to avoid food coloring.

9: **"Caramel coloring" isn't natural.**

It's sugar that has been highly processed with ammonia and sulfites. It has been shown to produce two carcinogenic chemicals in the body (related to lung, liver, and thyroid cancer, and leukemia). It's used in soda, tea, beer, liquor, baked goods, sauces and dips, dressings, gravies, and candy. I found it in NUMEROUS "healthy" products at two well-known "natural" grocery chains.

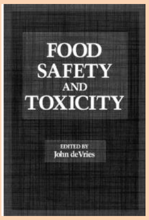
10: **The largest American food manufacturers are already selling dye-free versions of their popular products in other countries.**

Yes, they do have the means to change their production methods ... it's just cheaper to use chemicals. And our government hasn't been as proactive in encouraging a switch.

BOOK STOP

1. **Food Safety and Toxicity**

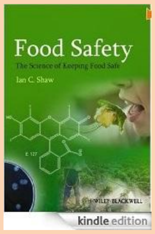
Author: **John De Vries**
Publisher: **CRC Press**
ISBN: **0849394880**
Pages: **368**



Synthetic food additives are extensively tested for toxicity before they are allowed for use in food.Color is a property of foodstuffs that makes them visually attractive.

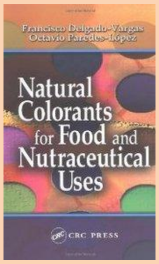
2. **Food Safety: The Science of Keeping Food Safe**

Publisher: **Wiley-Blackwell**
Author: **Ian C. Shaw**
ISBN: **978-1-443-3722-8**
Pages: **448**
The book takes a trip through the world food saftey from microbiologiacal food pathogen through chemical contaminats, natural toxin and chemical use to colour, preservative and flavour our food.



3. **Natural Colorants for Food and Nutraceutical Uses**

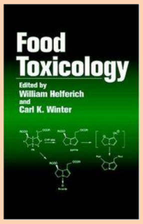
Author: **Francisco Delgado-Vargas, Octavio Paredes-Lopez**
Publisher: **CRC press**
ISBN : **1-58716-076-5**
Pages: **344**



The book contains information obtained from authentic and highly regarded sources.A fter centuries of using species and inorganic pigment resulted in current use of only limited numbers of them.

4: Food Toxicology

Author: **William Helferich, Carl K. Winte**
Publisher: **CRC Press**
ISBN: **0-8493-2760-1**
Pages: **240**



Weanling male Sprague-Dawley rats fed 10% psyllium seed or carrot powder show no toxicity from consuming 5% FD&C .10% wheat bran, or 10% alfalfa meal also significantly lessens toxic effects of the food color.

5: Textbook of Toxicology

Author: **Balram Pani**
Publisher:**IK-international publishing house Pvt Ltd**
ISBN : **978-93-80578-40-8**
Pages: **420**
The colour additive refers to a dye pigment and other substances to impart the colour. The certain additives are considered to be non-toxic by the government agencies related to food science.

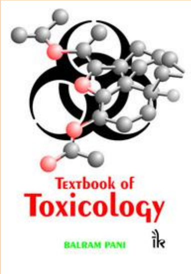


Table: Food dyes information

Food dyes	Summary	What it's in	What it causes
Blue #1 (Brilliant Blue)	Was not found to be toxic in key rat and mouse studies, but an unpublished study suggested the possibility that Blue 1 caused kidney tumors in mice, and a preliminary in vitro study raised questions about possible effects on nerve cells. Blue 1 may not cause cancer, but confirmatory studies should be conducted. The dye can cause hypersensitivity reactions. Added permanently to the food dye exemption list in 1982	Baked goods, beverages, desert powders, candies, cereal, drugs, and other products	Excreted in the bile, absorbs in the GI tract and intestine, becomes radioactive in the urine, chromosomal aberrations, kidney tumors, viral infections, microscopic lesions, the FDA nixed one study that a dog died in because the study did not have equal numbers of males and females (uh huh ...), kidney tumors, females showed decreased amount of weight and survival in utero, hyperactivity disorders in children, suggested that even in small amount would have a large effect on a child's brain growth, particularly worrisome for fetuses and infants
Blue #2 (Indigo Carmine)	Cannot be considered safe given the statistically significant incidence of tumors, particularly brain gliomas, in male rats. Added permanently to the food dye 'exemption' list in 1983 because it is 'claimed' that B2 cannot cross the blood-brain-barrier	Color beverages, candies, pet food, & other food and drugs.	Excreted in feces, bile, and small amount in urine, cell neoplasms in the urinary bladder, mammary-gland tumors and brain glimoas.
Citrus Red #2	Is permitted only for coloring the skins of oranges not used for processing, is toxic to rodents at modest levels and caused tumors of the urinary bladder and possibly other organs. The dye poses minimal human risk, because it is only used at minuscule levels and only on orange peels, but it still has no place in the food supply	Skins of Florida oranges.	Still intact in feces 48 hours later, broken down in GI tract, causes bladder cancer, found in urine (absorbed, sulfonated, and then excreted), tumors in liver, lungs, lymph nodes, increased fatty metamorphosis, significant weight gain in females, hyperplasia, thickening of urinary bladder wall causing papillomas, can be consumed by humans after peeling oranges.

Green #3 (Fast Green)	Caused significant increases in bladder and testes tumors in male rats. Though the Food and Drug Administration (FDA) considers it safe, this little-used dye must remain suspect until further testing is conducted.	Drugs, personal care products, cosmetic products except in eye area, candies, beverages, ice cream, sorbet; ingested drugs, lipsticks, and externally applied cosmetics.	Excreted in feces and bile, tests on dogs proved raise in pup mortality, testes tumors, liver neoplastic nodules, urinary neoplasms, studies found that mostly males were affected.
Red #3 (Erythrosine)	Recognized in 1990 by the FDA as a thyroid carcinogen in animals and is banned in cosmetics and externally applied drugs. All uses of Red 3 lakes (combinations of dyes and salts that are insoluble and used in low-moisture foods) are also banned. However, the FDA still permits Red 3 in ingested drugs and foods, with about 200,000 pounds of the dye being used annually.	Sausage casings, oral medication, maraschino cherries, baked goods, candies, some cosmetics	58% iodine content, excreted in bile which means the body absorbs and to some extent body tissue metabolizes it, those who use it normally have double the amount of protein iodine than those who do not, dye takes about 3 months to leave the body, ulcers, increased incidences of lyhmphocytic lymphoma in males, increased thyroid follicular cell adenomas in males, weight loss in adults and children, animal carcinogen.
Red #40 (Allura Red)	First produced at the Allied Chemical Corporation, most-widely used/consumed dye, may accelerate the appearance of immune-system tumors in mice. The dye causes hypersensitivity (allergy-like) reactions in a small number of consumers and might trigger hyperactivity in children.	Beverages, bakery goods, dessert powders, candies, cereals, foods, drugs, and cosmetics	Becomes radioactive in urine and stays radioactive in the guts (yes, you read that right ... even in small amounts), affects the stomach, lungs and colon, urticaria, angiodema, hypersensitivity in all patients tested, passes in utero and proves a significant decrease in body weight in females, was present in dogs system years later, reticuloendotheliel tumors did not show growth but were still there, aniline and other contaminants found.
Yellow #5 (Tartrazine)	Not carcinogenic in rats, but was not adequately tested in mice. It may be contaminated with several cancer-causing chemicals. In addition, Yellow 5 causes sometimes-severe	Pet foods, in numerous bakery goods, beverages, dessert powders, candies, cereals, gelatin desserts, and many other foods, as well as	Effects metabolism, accelerated urinary excretion, hyperactivity in children, induces chromosomal aberrations, studies done on infant rats proved more toxic and carcinogenic, benzidine and other contaminant level

	hypersensitivity reactions in a small number of people and might trigger hyperactivity and other behavioral effects in children. Posing some risks, while serving no nutritional or safety purpose. Y5 is contaminated with several carcinogens, including benzidine and 4-aminobiphenyl. All studies indicated that Y5 contains more parts per million than 'certifiably' allowed by FDA standards.	pharmaceuticals, and cosmetics.	found above FDA regulation. A study done by the FDA in 1990 says that Y5 found 4 cancers in 10 million people but that does not provide enough risk to pull its usage. The ratio is more than likely increased by 500% since 1990.
Yellow #6 (Sunset Yellow)	Caused adrenal tumors in animals, though that is disputed by industry and the FDA. It may be contaminated with cancer-causing chemicals and occasionally causes severe hypersensitivity reactions. Yellow 6 adds an unnecessary risk to the food supply. FDA-approved Form of Sunset yellow, is water soluble sulfonated azo dye.	Color bakery goods, cereals, beverages, dessert powders, candies, gelatin deserts, sausage, cosmetics and drugs	Adrenal tumors, severe hypersensitivity/hyperactivity, increased/ accelerated urinary excretion, urticaria, asthma angioedema of lips, eyes, or face; reddening of the eyes; sweating; increased tear secretion; nasal congestion; sneezing; rhinitis (runny nose); hoarseness; wheezing; and a variety of subjective symptoms.