



## AZO DYES USED IN FOOD ITEMS & ITS EFFECT ON HUMAN HEALTH

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### ABSTRACT:

Azo dyes are used to enhance the intensity of color to beautify food items. Azo dyes are widely used in cold drinks, cakes, ice-creams, chocolates, medicines, alcoholic beverages, juices etc. Azo dyes contain (N=N) group as chromophore which on reduction yields amines, phenols and other toxic materials, which severely affect human & animal health. Hyperactivity, asthma, restlessness, suffocation, allergy, skin diseases etc. are some of the proven side-effects of usage of these dyes; further, the development of tumours due to these is also being studied. Effects of four most widely used azo dyes Amarnath, Tartrazine, Red 40, and Sunset Yellow and their side effects are discussed in this paper.

**KEYWORDS:** Azo dyes, effect of human health, food item, toxicity.

### INTRODUCTION: -

Food manufactures prefer artificial synthetic colours because they are more vibrant, however due to safety all artificial dyes cannot be used in food industry. Regulatory authorities like Food and Drug Administration (FDA), and European Food Safety Authority (EFSA), and Food Safety and Standard Authority (FSSAI) in India decides the norms for usage of dyes as food additives. Artificial food dyes are petroleum derived material therefore the effect of these on human health is always a matter of concern.

Azo dyes are used to color food materials, natural and synthetic fibres, paper, leather, medicines, cosmetics, toys, hair, fur etc. Azo dyes are very cheap, they can even be prepared below room temperatures by using coupling reaction. These dyes have intense color and are stable in wide range of pH; they generally do not fade with the exposure of oxygen, exposure of light and even due to normal changes in nature. Most of these dyes are water soluble & insoluble in oils & fats; these maintain their intensity even after being added to large quantities of food item (e.g. few gms of azo dye added to a kg of food item).

Azo dyes account for more than 70% of all the colors used in food industry. These are found in all variants of colors but yellow, red, orange, green and blue are widely used. Among all the azo dyes Amarnath, Tartrazine, Red 40, and Sunset Yellow are predominantly used. These dyes are also used in candies, pickles, seeds, ice-creams, chocolates, soft drinks, sauces, alcoholic beverages etc.

Ready to eat food is an integral part of modern life style. In smaller families, kids and younger ones are influenced by television & social media to actively consume ready to eat foods; with intake of these food items, the additives like azo-dyes are also consumed and more often than not, they are consumed beyond the permissible limits decided by various government agencies.

Natural colors can also be produced using substances/sources like beet roots, carotenes, flowers & leaves but due to the limitation of choice of colors & lack of intensity; these aren't very

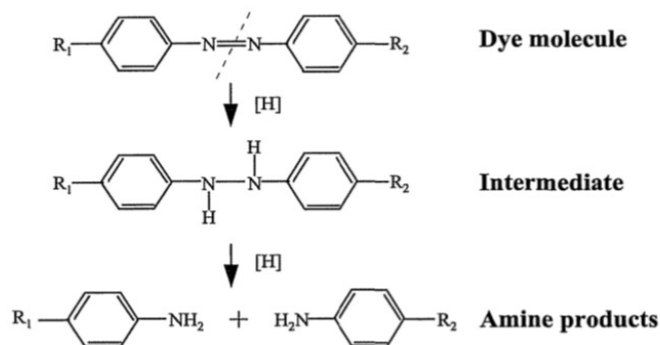
popular. Many journals in past have reported that continuous consumption of colors made of azo dyes can cause serious damage to human health.

### IMPACT OF AZO-DYES ON HUMAN HEALTH: -

Azo dyes absorb radiations in the range of 400-750 nm from visible spectrum. Dyes may have one or more than one azo groups in their structure. In azo dyes, benzene or naphthalene groups with different substituents like Amino ( $-\text{NH}_2$ ), Nitro ( $-\text{NO}_2$ ), Hydroxyl ( $-\text{OH}$ ), Carboxyl ( $-\text{COOH}$ ), Sulphonic ( $-\text{SO}_3\text{H}$ ), Chloro ( $-\text{Cl}$ ), methyl ( $-\text{CH}_3$ ) is present. On reduction, cleavage of azo group yields aromatic amines, phenols, and acids all of which are toxic in nature. It is known that reduction can take place via enzyme azoreductase which exists extracellularly in both skin and gut bacteria; in intestines, anaerobic bacteria reduce these dyes; the aromatic amine metabolically oxidize to reactive electrophilic species that covalently bind with DNA. Azo dyes may be activated via direct oxidation of Azo linkage yielding highly reactive diazonium salt.

Some azo dyes exhibit mutagenic activity, when azo dyes are reduced due to breaking of  $-\text{N}=\text{N}-$  bond, aromatic amines are formed. They can be either carcinogenic or mutagenic depending upon the chemical structure of amines involved. According to Plumb and yoo aromatic amines are more toxic than dye itself. When workers in textile industries were exposed to azo dyes for very long period, it is found that possibility of bladder cancer in them increased multiple times.

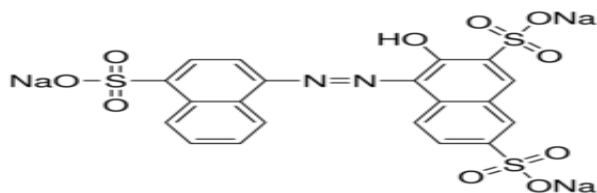
It is also reported that due to preservatives like sodium benzoate cause hyperactivity in kids. Due to all these reasons, toxicity of azo dyes remains a topic of discussion worldwide. Each and every country has its own authority that decides permissible limits of intake of these dyes in food material (in



per day per kg terms). It is also observed that many azo dyes are allowed in one country but other countries have banned them as food additives. Even United States & European Union have prescribed different limits for different additives in foods & beverages. In industrialized society, cases of intestinal cancer are increasing alarmingly. Food habits of people in such localities are always in purview of investigation.

### AMARNATH: -

Amarnath is a mono azo dye, its molecular weight is 604.49 gm/mole. It is also named as CI Food Red 9, E123, Nephthal Red-S or Acid Red 27. It is soluble in water (approx.70 g per litre at 25°C) and is insoluble in vegetable oils. It is supplied as sodium salt. It is available in powder as well granular form and its color is red brown. In solution it has bluish red color. As of today, maximum permissible limit of this dye in Europe is 30 mg/kg in food and 100 mg/L in alcoholic beverages.



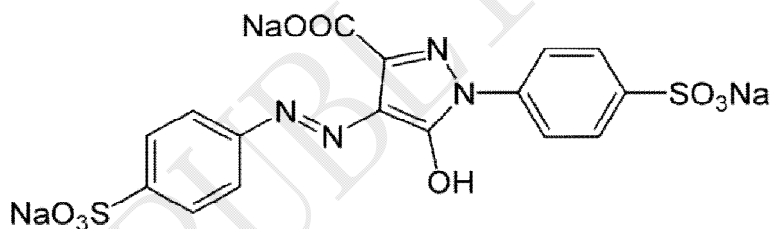
### Trisodium (4E)-3-oxo-4-[(4-sulfonato-1-naphthyl)hydrazono]naphthalene-2,7-disulfonate

Amaranth is anionic dye, used in sauces, snacks, jellies etc. In evaluating the overall toxicological database on this dye, when 50g/kgbw/day dose of Amaranth was given, enlargement of organ or tissue of cells which is often an initial stage of cancer development was found in rats. Hence the toxicity of Amaranth dyes is always a matter of discussion. Therefore, for kids maximum permitted limited is fixed as ADI of 0.1mg/kgbw/day and for adults it is prescribed as maximum 0.9mg/kgbw/day by EU.

### TARTRAZINE: -

Tartrazine is a monoazo dye, its molecular mass is 534.36 g/mol and it is water soluble (20g/100ml). It is also named as Yellow 5, Acid Yellow 23. Its EU number is E102 and C.I 19140. Originally it is yellow in colour and is used to produce Green shades with Brilliant Blue.

Tartrazine is used to produce bright yellow or green colours in ice-creams, candies, pastries, cake, biscuits jellies, soft drinks, alcohol beverages, corn and potato chips, chewing gum, pickles, sauces, noodles, salad, fruit juices etc. It is also used in cosmetics like lotions, perfumes soap, lipsticks toothpaste, shampoo.

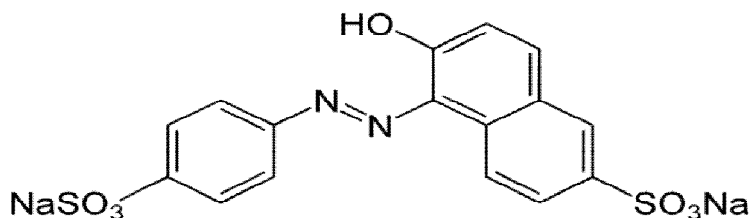


### Trisodium 1-(4-sulfonatophenyl)-4-(4-sulfonatophenylazo)-5-pyrazolone-3-carboxylate)

In pharmaceutical industry it is used in antacids, vitamins and other drugs. Excess consumption of Tartrazine is the cause of allergies, intolerance, asthma, hives and swelling.

### SUNSET YELLOW: -

This is also a monoazo dye. Its molecular mass is 452.36 and melting point is 300°C. It is also named as Orange Yellow S, Sunset Yellow FCF, C.I. 15985 and is denoted as E110.



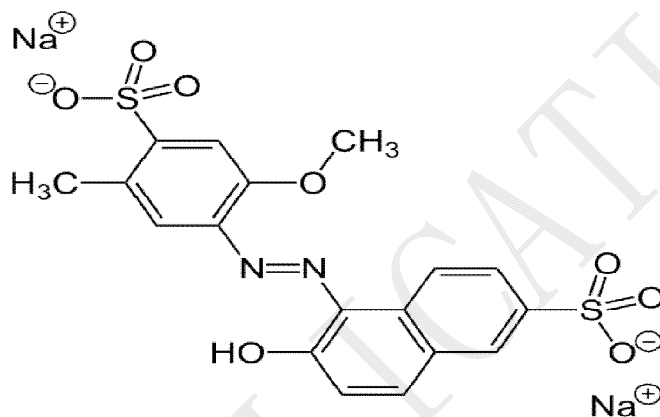
### Disodium 6-hydroxy-5-[(4-sulfophenyl)azo]-2-naphthalenesulfonate

Sunset Yellow dyes is used in food, cosmetics and drug. It produces orange red color in candy, desserts, snacks, sauces and in fruit juices. Its maximum permissible limit for a day is 3.76mg/kgbw/day. When it is used with preservative, hyperactivity increases. It is also used with amaranth to produce brown color in chocolates and caramel.

#### RED 40 DYE: -

This is also monoazo dyes. Its molecular mass is 496.42 gram/mol. It is available as Red powder. It is supplied as sodium salt. It is also named as Allura Red, Food Red 17, C.I 16035 or E129

It is used in tattoo inks, soft drinks, cherry, dairy products, candies, confectionary items alcoholic beverages etc. Its maximum permissible limit is 7mg/kgbw/day. It is reported that excess consumption of this is a cause of hyperactivity. Studies of the toxicity of all these dyes in many countries have caused ban on some azo dyes in some countries.



**Disodium 6-hydroxy-5-[(2-methoxy-5-methyl-4-sulfonatophenyl)diazenyl]naphthalene-2-sulfonate**

Experts are of the opinion that only natural color should be permitted in food item but the same is not possible because of market forces; thus, the solution to this is that per day consumption per kg body weight must be specified and implemented strictly.

#### CONCLUSION: -

Artificial food dyes are products derived from petroleum, having -N=N- group, which on reduction forms aromatic amines and acidic products, which are even more toxic than dyes itself. Azo dyes are cause of allergy, hyperactivity, restlessness, depression, difficulties in sleeping, anxiety, suffocation etc. Many researchers claim that these dyes are a cause of cancer too while others report that cancer is not caused by these dyes. Thus, to be on safer side food safety authority warns that excess consumption of these dyes is harmful to human health, but within limit consumption is safe; and thus, the prescribed limits should be strictly adhered to.

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