COLOUR OF ECOFRIENDLY DYES USED IN HOLI RATHER THAN TRIPHENYL METHANE DYES

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ABSTRACT

Environmentally friendly, environment-friendly, eco-friendly, nature-friendly and green are marketing claims referring to goods and services, laws, guidelines and policies that inflict reduced, minimal, or no harm at all, upon ecosystems or the environment. Triphenylmethane dye, any member of a group of extremely brilliant and intensely coloured synthetic organic dyes having molecular structures based upon that of the hydrocarbon triphenylmethane. They have poor resistance to light and to chemical bleaches and are used chiefly in copying papers, in hectograph and printing inks and in textile applications for which light fastness is not an important requirement. The triphenylmethane derivatives are among the oldest man-made dyes, a practical process for the manufacture of fuchsine having been developed in 1859. Several other members of the class were discovered before their chemical constitutions were fully understood. Crystal violet, the most important of the group, was introduced in 1883. The range of colours is not complete but includes reds, violets, blues, and greens. They are applied by various techniques, but most belong to the basic class, which are adsorbed from solution by silk or wool, but have little affinity for cotton unless it has been treated with a mordant such as tannin.

KEY WORDS: Triphenyl methane, Leuco base, Natural colour, Synthetic colour, Dry colour, Wet colour, Malachite green, Crystal violet, Fuschin, Metanil yellow.
INTRODUCTION

Only a century earlier, dyes were used to color fabrics only. They were substances that changed the color of a fabric when the piece of fabric was dipped for sometime in an aqueous solution of this dye. Many substances found naturally are examples of dyes such as plant sources (roots and leaves of plants). However, in modern times, synthetic dyes are preferred as they provide more vibrant and long lasting colors to fabrics. There are even food dyes that are used to change the color of the food. These are additives that are produced to a higher standard than dyes used for fabrics as they affect human health. Similarly, there are other dyes that are also produced keeping in mind safety of human beings and their sensitivities of human skin to various chemicals.[1]

![Color of Holi](image1)

Figure-1: Colour of Holi

Ideally, the joyous festival of Holi is meant to celebrate the arrival of Spring while the colors used in Holi are to reflect of the various hues of spring season. But unfortunately, in modern times Holi does not stand for all things beautiful. Like various other festivals, Holi too has become ruthlessly commercialized, boisterous and yet another source of environmental
degradation. To de-pollute Holi and make it in sync with nature, as it is supposed to be, several social and environmental groups are proposing a return to more natural ways of celebrating Holi. The aim of this article is to generate awareness amongst people about the various harmful effects around Holi celebrations and encourage people to celebrate an eco-friendly Holi!

**The three main environmental concerns around Holi**

1. The use of toxic chemical colours.
2. The use of wood for burning Holi fires.
3. The wasteful use of water during Holi.

**1. Harmful Effects of Chemical Colours**

In earlier times when festival celebrations were not so much commercialized Holi colors were prepared from the flowers of trees that blossomed during spring, such as the Indian Coral Tree (parijat) and the Flame of the Forest (Kesu), both of which have bright red flowers. These and several other blossoms provided the raw material from which the brilliant shades of Holi colours were made. Most of these trees also had medicinal properties and Holi colors prepared from them were actually beneficial to the skin. Over the years, with the disappearance of trees in urban areas and greater stress for higher profits these natural colours came to be replaced by industrial dyes manufactured through chemical processes. Around 2001, two environmental groups called Toxics Link and Vatavaran, based in Delhi, did a study on all the three available categories of colours available in the market - pastes, dry colours and water colours. The study revealed that all of these three forms of chemical Holi colors are hazardous. Harmful Chemicals in Holi Paste type colors According to their researched fact sheet on Holi, the pastes contain very toxic chemicals that can have severe health effects.

**Table-1: Colour and Killer**

<table>
<thead>
<tr>
<th>Color</th>
<th>Chemical</th>
<th>Health Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>Lead oxide</td>
<td>Renal Failure</td>
</tr>
<tr>
<td>Green</td>
<td>Copper Sulphate</td>
<td>Eye Allergy, Puffiness and temporary blindness</td>
</tr>
<tr>
<td>Silver</td>
<td>Aluminium Bromide</td>
<td>Carcinogenic</td>
</tr>
<tr>
<td>Blue</td>
<td>Prussian Blue</td>
<td>Contact Dermatitis</td>
</tr>
<tr>
<td>Red</td>
<td>Mercury Sulphite</td>
<td>Highly toxic can cause skin cancer</td>
</tr>
</tbody>
</table>
Harmful Chemicals in Gulal
The dry colours, commonly known as gulals, have two components – a colourant that is toxic and a base which could be either asbestos or silica, both of which cause health problems. Heavy metals contained in the colourants can cause asthma, skin diseases and adversely affect the eyes. Harms of Wet Holi Colors Wet colours, mostly use Gentian violet as a colour concentrate which can cause skin discolouration and dermatitis. These days, Holi colours are sold loosely, on the roads, by small traders who often do not know the source. Sometimes, the colours come in boxes that specifically say ‘For industrial use only.’

Homemade Holi colours
Holi festival lovers will be thrilled to know that it is possible to make simple natural colors in one’s own kitchen. Here are some very simple recipes to make natural colours:

<table>
<thead>
<tr>
<th>Color</th>
<th>Method of Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>1. Mix turmeric (haldi) powder with chick pea flour (besan).</td>
</tr>
<tr>
<td></td>
<td>2. Boil Marigold or Tesu flowers in water.</td>
</tr>
<tr>
<td></td>
<td>3. Yellow liquid color Soak peels of pomegranate (Anar) overnight.</td>
</tr>
<tr>
<td>Deep Pink</td>
<td>Slice a beetroot and soak in water.</td>
</tr>
<tr>
<td>Orange</td>
<td>Henna leaves (mehndi) can be dried, powdered and mixed with water.</td>
</tr>
</tbody>
</table>

Purchase Natural Holi Colors
For those who do not have the time to make their own colours, there is the choice of buying natural Holi colours. Several groups are now producing and promoting such colours, although it is important to verify the ingredients of the colours and ensure you know enough about the source.

2. The Holi Bonfire
The burning of fuel wood to create the bonfire for Holika Dahan presents another serious environmental problem. According to a news article, studies done in the state of Gujarat reveal that each bonfire uses around 100 kg of wood, and considering that approximately 30,000 bonfires are lit in the state of Gujarat just for one season, this leads to a wastage of a staggering amount of wood. Groups such as Sadvichar Parivar are now advocating one symbolic community fire, rather than several smaller bonfires across the city as a way to reduce wood consumption. Others are also suggesting that these fires be lit using waste material rather than wood.

3. A Dry Holi?
In the current situation, when most cities in India are facing acute water scarcity, the wasteful use of water during Holi, is also being questioned. It is common for people to douse each other with buckets of water during Holi, and children often resort to throwing water balloons.
at each other. The idea of a dry Holi seems alien at first, especially as the climate becomes warmer around Holi, and the water provides welcome relief from the heat. However, considering that in some urban areas, citizens can go without water for several days, it seems wasteful to use so much water simply for a celebration. Environmental Consciousness Amongst People It is a relief to notice that the awareness about the environmental impacts of celebrating Holi are being brought to light by various NGOs. And gradually, more and more Indians are choosing to turn to a more natural and less wasteful way of playing Holi.\[3\]

**Green**

**Dry Colour**
Use mehendi/henna powder, separately or mix with equal quantity of any suitable flour to attain a lovely green shade. Make use only pure mehendi and not the one mixed with amla as this would be brown in colour. Dry mehendi will not leave colour on your face as it can be easily brushed off. Only when it is a paste will it leave a slight colour on your face. Thus, it can be used as a pucca/fast colour. Many people like smearing other person's hair with colours. How about doing it with mehendi powder and saving a trip to the parlour?

**Other methods**
Dry and finely powder the leaves of Gulmohur (*Delonix regia*) tree for a green colour. Crush the tender leaves of the Wheat plant to obtain a natural safe green Holi colour.

**Wet colour**
Mix two teaspoons of mehendi in one litre of water. Stir well. Green colour can also be obtained by mixing a fine paste of leaves like spinach/palak, coriander/dhaniya, mint/pudina, tomato leaves, etc. in water.\[4\]

**Yellow**

**Dry colour**
Mix two teaspoons of haldi/Turmeric powder with double quantity of besan (gram flour). Haldi and besan are extremely healthy for our skin, and are also used widely as a ubtan while taking bath. You can use the ordinary haldi or "kasturi" haldi which is very fragrant and has enhanced therapeutic effects. Besan can be substituted by atta, maida, rice flour, arra rot (ground nut) powder, fuller's earth (multani mitti) and even talcum powder.\[5\]
Another Method
Flowers like Amaltas (*Cassia fistula*), Marigold/Gainda (*Tagetes erecta*), Yellow Chrysanthemums, Black Babul (*Acacia arabica*) yield different shades of yellow. Dry the petals of these flowers in shade and crush them to obtain a fine powder. Mix appropriate quantity of the powder with besan, etc. or use separately. Dry the rind of the Bael fruit (*Aegle marmelos*) and grind to obtain a yellow powder.

Wet Colour
Add one teaspoon of haldi to two litres of water and stir well. This can be boiled to increase the concentration of colour and further diluted. Soak Amaltas (*Cassia fistula*) or Marigold/Gainda (*Tagetes erecta*) flowers in water. Boil and leave overnight.[6]

**Red**

Dry Colour
Red Sandal Wood Powder/Raktachandan/Lalchandan (*Pterocarpus santalinus*) has a beautiful red colour, is extremely beneficial for the skin and is used in face packs, etc. This can be used instead of Red Gulal. Dry red hibiscus flowers in shade and powder to make a lovely red colour. To increase the bulk add any flour to it. Sinduria, called Annato in English has a water chestnut shaped fruit which contains lovely brick colour red seeds. These yield both dry and wet colours.[7]

Wet colour
Put 2 teaspoons of Red Sandal wood powder in a litre of water and boil. Dilute and use. Peels of Red Pomegranate boiled in water give red. For a bright orangish-red, mix thoroughly a pinch of chuna/lime powder (the one that we eat with our paan/betel leaves) with 2 spoons of haldi/turmeric powder and a few drops of water. Use only after diluting with 10 litres of water.[8]

Extracting red from flower petals
Buras (*Rhododendron arboreum*) known as Burans in the Garhwal hills and Brans in the Kumaon hills gives a lovely red colour when soaked in water overnight. Red hibiscus flowers soaked in water overnight give a red which also has medicinal value. The Palita Madar/Pangri/Indian Coral tree (*Erythrina indica*), found commonly in coastal regions, has large red flowers. Soak the flowers in water overnight. Boil wood of Madder Tree in water for a deep red. Red colour can also be obtained from juice of tomatoes and carrots. This can be diluted with sufficient quantity of water to remove the stickiness.[9]
Blue
Dry Colour
The Jacaranda flowers can be dried in the shade and ground to obtain a beautiful blue powder. The flowers bloom in summers. The blue Hibiscus which is found in Kerala can be dried and powdered just like the red hibiscus.\[^{10}\]

Wet Colour
Crush the berries (fruits) of the Indigo plant and add to water for desired colour strength. In some Indigo species the leaves when boiled in water yield a rich blue.\[^{11}\]

Magenta
Wet Colour
Slice or grate one Beet root. Soak in 1 litre of water for a wonderful magenta. Boil or leave overnight for a deeper shade. Dilute. Boil the peels of 10-15 pink Onions in half litre of water for an orangish-pink colour. Remove the peels before using to remove the smell. Soak Kachnar (Bauhinia variegata) flowers (pink variety) in water overnight, or boil for a pinkish colour.\[^{12}\]

Saffron
Wet Colour
The Flame of the Forest (Butea monosperma), known as Tesu, Palash or Dhak in vernacular languages, is the source of the wonderful, traditional colour for Holi. The flowers are soaked overnight in water and can also be boiled to obtain fragrant yellowish-orange colored water. The dried flowers can be dried and powdered for a orange powder. Legend says that Lord Krishna used to play Holi with Tesu flowers, and the flowers also have a lot of medicinal properties. Tesu blooms during month of March. Boil flower petals of red variety of Semul/Silk Cotton (Bombax ceiba) in water. Collect and dry the stalks of Harashringar/Parijatak (Nyctanthes arbor-tristis) flowers during the early winter season. Soak them in water to get a pleasant coloured orange. Mix a pinch of Sandalwood powder from Ujjain in one litre of water for an instant, beautiful and fragrant saffron colour. Soak a few stalks of Saffron/Kesar in 2 table spoons of water. Leave for few hours and grind to make a fine paste. Dilute with water for desired colour strength. Though expensive, it is excellent for our skin.\[^{13}\]
Brown  
**Wet Colour**
Kattha (*Acacia catechu*), the one eaten in pan, when mixed with water will give a brownish colour. Boil Tea or Coffee leaves in water. Cool and use.\[^{14}\]

Black  
**Wet Colour**
Boil dried fruits of Amla/Indian Gooseberry in an iron vessel and leave overnight. Dilute with water and use. Extract juice of black grapes and dilute with sufficient quantity of water to remove stickiness.\[^{15}\]

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![Figure-2: Significance of Colour](image-url)
Malachite Green is an organic compound that is used as a dyestuff and has emerged as a controversial agent in aquaculture. Malachite Green is traditionally used as a dye for materials such as silk, leather, and paper. Although called malachite green, the compound is not related to the mineral malachite — the name just comes from the similarity of color.[16]

Structures and properties
Malachite Green is classified in the dyestuff industry as a triarylmethane dye and also using in pigment industry. Formally, Malachite Green refers to the chloride salt [C₆H₅C(C₆H₄N(CH₃)₂)₂]Cl, although the term Malachite Green is used loosely and often just refers to the colored cation. The oxalate salt is also marketed. The chloride and oxalate anions have no effect on the color. The intense green color of the cation results from a strong absorption band at 621 nm (extinction coefficient of 10⁵ M⁻¹ cm⁻¹). Malachite Green was first prepared by Fischer in 1877 by condensing benzaldehyde and dimethylaniline in the molecular ratio 1:2 and in the presence of a dehydrating agent.

Malachite Green is prepared by the condensation of benzaldehyde and dimethylaniline to give leuco Malachite Green (L- Malachite Green):

C₆H₅CHO + 2 C₆H₅N(CH₃)₂ → C₆H₅CH(C₆H₄N(CH₃)₂)₂ + H₂O

Second, this colorless leuco compound, a relative of triphenylmethane, is oxidized to the cation that is Malachite Green:

C₆H₅CH(C₆H₄N(CH₃)₂)₂ + HCl + 1/2 O₂ → [C₆H₅C(C₆H₄N(CH₃)₂)₂]Cl + H₂O

A typical oxidizing agent is manganese dioxide.[17]

Figure-3: Malachite Green

On the left is leuco-Malachite Green (Malachite Green) and on the right are the two equivalent resonance structures of the Malachite Green cation. The carbinol derivative of
Malachite Green is derived from L-Malachite Green by replacement of the unique C-H by COH.\textsuperscript{[8]}

Hydrolysis of Malachite Green gives the carbinol form:

\[ \text{[C}_6\text{H}_5\text{C(C}_6\text{H}_4\text{N(CH}_3\text{)}_2\text{)]Cl} + \text{H}_2\text{O} \to \text{C}_6\text{H}_5\text{C(OH)(C}_6\text{H}_4\text{N(CH}_3\text{)}_2 + \text{HCl} \]

<table>
<thead>
<tr>
<th>Malachite Green (first transition) (pH indicator)</th>
</tr>
</thead>
<tbody>
<tr>
<td>below pH 0.2</td>
</tr>
<tr>
<td>above pH 1.8</td>
</tr>
</tbody>
</table>

\[ \text{0.2} \leftrightarrow \text{1.8} \]

<table>
<thead>
<tr>
<th>Malachite Green (second transition) (pH indicator)</th>
</tr>
</thead>
<tbody>
<tr>
<td>below pH 11.5</td>
</tr>
<tr>
<td>above pH 13.2</td>
</tr>
</tbody>
</table>

\[ \text{11.5} \leftrightarrow \text{13.2} \]

**Figure-4: Variable pH of Malachite Green**

This alcohol is important because it, not Malachite Green, traverses cell membranes. Once inside the cell, it is metabolized into L-Malachite Green. Only the cation Malachite Green is deeply colored, whereas the L-Malachite Green and carbinol derivatives are not. This difference arises because only the cationic form has extended pi-delocalization, which allows the molecule to absorb visible light.\textsuperscript{[19]}
Malachite Green is traditionally used as a dye. Millions of kilograms of Malachite Green and related triarylmethane dyes are produced annually for this purpose. Malachite Green is active against the oomycete Saprolegnia, which infects fish eggs in commercial aquaculture and other fungi. Furthermore, Malachite Green is also used as a parasiticide and antibacterial. It is a very popular treatment against ichthyophthirius in freshwater aquaria. The principal metabolite, L-Malachite Green, is found in fish treated with malachite green, and this finding is the basis of controversy and government regulation. See also Antimicrobials in aquaculture. Malachite Green has frequently been used to catch thieves and pilferers. The bait, usually money, is sprinkled with the anhydrous powder. Anyone handling the contaminated bait will find that on washing the hands, the contact with water will provoke an indelible green stain on the skin lasting for several days.$^{[20]}$

Numerous niche applications exploit the intense color of Malachite Green. It is used as abiological stain for microscopic analysis of cell biology and tissue samples. In the Gimenez staining method, basic fuchsin stains bacteria red or magenta, and Malachite Green is used as a blue-green counterstain. Malachite Green is also used in endospore staining since it can directly stain endospores within bacterial cells; here a safranin counterstain is often used. Malachite Green can also be used as a saturable absorber in dye lasers, or as a pH indicator between pH 0.2–1.8. However this use is relatively rare. Leuco-Malachite Green (LMalachite Green) is used as a detection method for latent blood in forensic science.
Hemoglobin catalyzes the reaction between Malachite Green and hydrogen peroxide, converting the colorless L-Malachite Green into malachite green. Therefore, the appearance of a green color indicates the presence of blood.\textsuperscript{21}

\textbf{Figure-6: Holi of Colour & Colour of Holi}

\textbf{Regulation}

In 1992 Canadian authorities determined that eating fish contaminated with Malachite Green posed a significant health risk. Malachite Green was classified a Class II Health Hazard. Due to its low manufacturing cost, Malachite Green is still used in certain countries with less restrictive laws for non-aquaculture purposes. In 2005, analysts in Hong Kong found traces of Malachite Green in eels and fish imported from China and Taiwan. In 2006 the United States Food and Drug Administration (FDA) detected Malachite Green in seafood imported from China, among others, where the substance is also banned for use in aquaculture. In June 2007, the FDA blocked the importation of several varieties of seafood due to continued Malachite Green contamination. The substance has been banned in the United States since 1983 in food-related applications. It is banned in the UK also. Aquatic animals metabolize
Malachite Green to its leuco form. Being non-polar, L- Malachite Green is retained in catfish muscle longer (t1/2= 10 days) than is Malachite Green (t1/2 = 2.8 days). Toxicity The LD50 (oral, mouse) is 80 Malachite Green /kg. Rats fed Malachite Green experience "a dose-related increase in liver DNA adducts" along with lung adenomas. Leuco-Malachite Green causes an "increase in the number and severity of changes". As leuco-Malachite Green is the primary metabolite of Malachite Green and is retained in fish muscle much longer, most intake of Malachite Green would be in the leuco form. During the experiment, rats were fed up to 543 ppm of leuco-malachite green, an extreme amount compared to the average 5 ppb discovered in fish. After a period of two years, an increase in lung adenomas in male rats was discovered but no incidences of liver tumors. Therefore it could be concluded that Malachite Green caused carcinogenic symptoms, but a direct link between Malachite Green and liver tumor was not established.\cite{22}

Figure-7: Crystal Violet

Crystal violet or gentian violet (also known as methyl violet 10B, hexamethyl pararosaniline chloride, or pyoctanin) is a triarylmethane dye. The dye is used as a
histological stain and in Gram's method of classifying bacteria. Crystal violet has antibacterial, antifungal, and anthelmintic properties and was formerly important as a topical antiseptic. The medical use of the dye has been largely superseded by more modern drugs, although it is still listed by the World Health Organization.

The name "gentian violet" was originally used for a mixture of methyl pararosaniline dyes (methyl violet) but is now often considered a synonym for crystal violet. The name refers to its colour, being like that of the petals of a gentian flower; it is not made from gentians or from violets. A number of possible routes can be used to prepare crystal violet. The original procedure developed by Kern and Caro involved the reaction of dimethylaniline with phosgene to give 4,4'-bis(dimethylamino)benzophenone (Michler's ketone) as an intermediate. This was then reacted with additional dimethylaniline in the presence of phosphorus oxychloride and hydrochloric acid. The dye can also be prepared by the condensation of formaldehyde and dimethylaniline to give a leuco dye:

$$\text{CH}_2\text{O} + 3 \text{C}_6\text{H}_5\text{N(CH}_3\text{)}_2 \rightarrow \text{CH(C}_6\text{H}_4\text{N(CH}_3\text{)}_3} + \text{H}_2\text{O}$$

Second, this colourless compound is oxidized to the coloured cationic form: (A typical oxidizing agent is manganese dioxide).\(^{23}\)

$$\text{CH(C}_6\text{H}_4\text{N(CH}_3\text{)}_3} + \text{HCl} + \frac{1}{2} \text{O}_2 \rightarrow [\text{C(C}_6\text{H}_4\text{N(CH}_3\text{)}_3}]\text{Cl} + \text{H}_2\text{O}$$
<table>
<thead>
<tr>
<th>Common Name</th>
<th>Synonym</th>
<th>C.I. Generic Name</th>
<th>Common Name</th>
<th>Synonym</th>
<th>C.I. Generic Name</th>
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<tbody>
<tr>
<td>Alcian yellow GXS</td>
<td>Sudan orange</td>
<td>Ingrain yellow 1</td>
<td>Methyl orange</td>
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<tr>
<td>Alizarin</td>
<td>Mordant red 11</td>
<td>Methyl red</td>
<td>Acid orange 2</td>
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<td>Alizarin red S</td>
<td>Mordant red 3</td>
<td>Naphthalene black 12B</td>
<td>Amido black 10B</td>
<td>Acid black 1</td>
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</tr>
<tr>
<td>Alizarin yellow GG</td>
<td>Mordant yellow 1</td>
<td>Naphthol green B</td>
<td>Acid green 1</td>
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<tr>
<td>Alizarin yellow R</td>
<td>Mordant orange 1</td>
<td>Naphthol yellow S</td>
<td>Acid yellow 1</td>
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<td>Azophloxin</td>
<td>Azogeranin B</td>
<td>Acid red 1</td>
<td>Orange G</td>
<td>Acid orange 10</td>
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<tr>
<td>Bismarck brown R</td>
<td>Vesuveine brown</td>
<td>Basic brown 4</td>
<td>Rose bengal</td>
<td>Acid red 94</td>
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<tr>
<td>Bismarck brown Y</td>
<td>Vesuveine Phenylene brown</td>
<td>Basic brown 1</td>
<td>Sudan II</td>
<td>Solvent orange 7</td>
<td></td>
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<tr>
<td>Brilliant cresyl blue</td>
<td>Cresyl blue BBS</td>
<td>Basic dye</td>
<td>Titan yellow</td>
<td>Direct yellow 9</td>
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<tr>
<td>Chrysoidine R</td>
<td>Basic orange 1</td>
<td>Tropaeolin O</td>
<td>Sulpho orange</td>
<td>Acid orange 6</td>
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<td>Chrysoidine Y</td>
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<td>Tropaeolin OO</td>
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<td>Congo red</td>
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<td>Tropaeolin OOO</td>
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<td>Crystal violet</td>
<td>Basic violet 3</td>
<td>Victoria blue 4R</td>
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<td>Fuchsin acid</td>
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<tr>
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<td>Yellow 2G</td>
<td>Acid yellow 17</td>
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<td>Martius yellow</td>
<td>Acid yellow 24</td>
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<tr>
<td>Meldola blue</td>
<td>Phenylene blue</td>
<td>Basic blue 6</td>
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<tr>
<td>Metanil yellow</td>
<td>Acid yellow 36</td>
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<td></td>
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</tbody>
</table>
**Fuchsine** (sometimes spelled *fuchsin*) or **rosaniline hydrochloride** is a magenta dye with chemical formula $C_{20}H_{19}N_3\cdot\text{HCl}$.

There are other similar chemical formulations of products sold as fuchsine, and several dozen other synonyms of this molecule. It becomes magenta when dissolved in water; as a solid, it forms dark green crystals. As well as dying textiles, fuchsine is used to stain bacteria and sometimes as a disinfectant. In the literature of biological stains the name of this dye is frequently misspelled, with omission of the terminal -e, which indicates an amine. American and English dictionaries (Webster's, Oxford, Chambers etc.) give the correct spelling, which is also used in the literature of industrial dyeing. It is well established that production of fuchsine results in development of bladder cancers by production workers. Production of magenta is listed as a circumstance known to result in cancer.\(^{[24]}\)
**Metanil yellow** is the principal non-permitted food colour used extensively in India. The effects of long-term consumption of metanil yellow on the developing and adult brain were studied using Wistar rats.

Regional levels of noradrenaline, dopamine and serotonin, activity of acetylcholine esterase (AChE), and operant conditioning with food reward were assessed in rats fed, metanil yellow and in controls. In the treated rats the amine levels in the hypothalamus, striatum and brain stem were significantly affected, and the changes were not generally reversible even after withdrawal of metanil yellow in developing rats. The striatum showed an early reduction of AChE activity, whereas the hippocampus showed a delayed but persistent effect of reduced AChE activity. Treated rats also took more sessions to learn the operant conditioning behaviour. These effects on these major neurotransmitter systems and on learning, indicate that chronic consumption of metanil yellow can predispose both the developing and the adult central nervous system (CNS) of the rat to neurotoxicity.\footnote{25}
CONCLUSION

Colours used in Holi are meant to reflect the various hues of the spring season. Holi, as you already know, is a celebration of the arrival of spring. The colours used during Holi once upon a time were prepared from the flowers of trees that blossomed during spring. Most of these trees also had medicinal properties and the colours obtained from them were highly beneficial to the skin. With the rapid commercialization of this festival and a strong demand for other colours, manufacturers started producing artificial colours, which are not only more sought after, but also inexpensive as compared to natural colours. What people tend to ignore is that these artificial colours consist of a large number of chemicals, which can have severe ill-effects on your health.

REFERENCES
10. Adams E. Q. and Rosenstein L.; "The color and ionization of crystal-violet". J. Amer. Chem. Soc. 36(7); 1452–1473: 1914.