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Consumer Awareness and Contemporary Policy Regulations on Artificial Food Colourants Safety in India

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Abstract

The purpose of this research is to focus on the most practised Artificial Food Colourants (AFCs) creating a demand in the consumer food market and neglecting food safety by the stakeholders, as these AFCs have been proven to be harmful to human health. The problem question that has been addressed here is whether the labeling policy and the consumer awareness of AFC are in tandem with; how the Indian judiciary fared in delivering their judgements towards the prevalence of non-permitted AFCs in the Indian food market to tell them as successful for the healthier consumer food industry. The main objective is to examine the consumers's awareness on AFC on the International Numbering System for Food Additives (INS) and their mentioning on the label of food products along with the regulatory measures for approvals of AFCs in Europe, USA and India for comparison. It is revealed that consumers' awareness of INS is not very significant; FSSAI permits only eight AFCs for consumption, nevertheless, other non-permitted AFCs were also found to be used and the Indian government has acted responsibly on various occasions by entering the manufacturing premises to inspect the food, collect samples for testing the adulteration by submitting to the food analyst, thereby curbing such activities and grabbing such offenders to the court. The concept of food safety dimensions in consensus with AFC practices, the health and legal issues associated with AFC consumption, the Indian Government's policies and the response of the judiciary related to food colourants safety are discussed in this paper. A doctrinal research method is followed by analysing the legal literature such as the regulatory provisions, government policies and noteworthy cases from the Indian judiciary and drawing support from empirical research evidencing the poor knowledge of consumers on AFCs being added in the food. Therefore, a serious policy awareness among consumers with respect

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to AFCs, being responsible and taking ownership towards one's own health and their family members by taking steps in questioning the consumer forum, avoiding purchase of such packed food which does not adhere to the labeling standards and being consumer friendly. Stringent regulations in labeling standards of packaged food in the USA and Europe due to the import nature of their products are the need of the hour.

Introduction

The concept of food colourant practices has evolved over time and now colours have become a part of life among humans psychologically, followed in the physical world and each individual has a taste for a particular colour treating it as their favourite.[1,2] This becomes the best challenge for marketers to fulfil the consumers' desires. Colours have a significant influence when it comes to the painting of houses connecting it to feng-shui, the clothes, cosmetics and jewellery we wear to match or contrast the colours, and also as a prominent feature in the Fast-Moving Consumer Goods (FMCG) packaging, [3,4,5] and most importantly the food that we consume to make it appear more appetizing. Before we taste the food, our eyes taste the food by its colour in most of the situations. For instance, Fanta and Miranda which do not contain any fruit or pulp, our eyes decide it as orange juice. Similarly, the food colouring decides the quality of the food psychologically. Human mindset tends to tilt towards specific colours in tying their recognition in terms of vegetables, fruits, and other food materials such as strawberry ice cream in pink, grape juice in blue, tomato ketchup in red colour, etc.[6] In case of changes in the colour of the food, it might not be identified as the taste of that food correctly, or otherwise bringing down the value of the food quality. Before purchasing any products, consumers will decide on the product's colour and then select the product when the colour meets their perceptions.[6] This has inherently increased the food colourant practices in the market and such adulterations have been side-lined by the sellers. Since colour acts as an effective tool for conveying complete information about a brand, aiding in brand awareness, influencing consumer opinions and having a different significance in each culture, while certain colour combinations measure positive in some cultures and negative in others,[4-7] this led the food marketers to influence consumers' buying visual cues, adopted to make judgments (e.g., food photographs) before the final consumption. The colour and aesthetic preferences of customers may impact their purchasing choices. Even if the price of the items is crucial, the colour, size, and packaging of the products influence the purchase choice.[8-10] With flooded FMCGs, where food, rates the highest and plays a major role in the economy, the colouring of food by the sellers has played a pivotal role in attracting consumers, thereby raising issues on artificial food colourant practices and their policies. These AFCs are either produced in a laboratory or isolated from chemicals or they are extracted from the by-product of petroleum and are harmful to human health causing various health hazards. The review brings to light the colour psychology impact on the consumer food market and that marketing strategies are tuned accordingly paying no attention to scientific reasons that state the harmful nature of the AFCs. The problem question that has been addressed here is whether the labeling policy and consumer awareness of AFC are in tandem with; how the Indian judiciary fared in delivering their judgements towards the prevalence of non-permitted AFCs in the Indian food market to see them as successful for the healthier consumer food industry. Hence the study aims to comprehensively investigate the regulation and usage of AFCs in India, USA and Europe; analyzing consumer awareness of INS in India and its understanding.

Materials and Methods

The materials appropriated for the study are statutory provisions from India, Europe, and the United States of America (USA); and judgements from the Indian judiciary; questionnaire adoption for empirical data. A mixed methods approach has been considered to justify and build a nexus between the doctrinal and empirical data. To find consumer awareness in India of INS numbering and mentioning them on packaged food labels, the researcher followed the quantitative method and convenient sampling approach, a non-probability sampling, for collecting responses anonymously by posting the structured questionnaire

via Google Forms link on social media like LinkedIn, X (Twitter), and Instagram in India, hence negating the selection of participants individually. Comrey and Lee,[11] a sample size below 50 is considered weak, 51 to 100 is moderately weak, 101 to 200 is deemed adequate, 201 to 300 is strong, 301 to 500 is very strong. In this case, the study's sample size falls within the very strong range. Data was received from 365 respondents and a percentage analysis was carried out in SPSS version 25 software due to its user-friendly interface and comprehensive statistical capabilities, enabling effortless calculation and interpretation of percentages from data.

Health Risks Associated with Artificial Colours and their Approvals

The edible food colours are practised in either food, drug or cosmetic industries or all of these cases. The approvals of these AFCs through regulations differ in various countries.

Regarding the food industry the following regulations are referred –

In India:

- The Food Safety and Standards Act (FSSAI), 2006;
- Food Products Standards and Food Additives Regulations, 2011. Chapter 3.1.2;[12]

In Europe:

- Regulation (EC) No 231/2012, which sets out specifications for food additives listed in Annexes II and III to Regulation (EC) No 1333/2008;[13]

In the USA:

- Federal Food, Drug, and Cosmetic Act (FD&C Act), Amendment 2023, 21 CFR 74(A)(A)[14]

Regarding the drug industry the following regulations are referred -

In India:

- Drug and Cosmetic Act, 1945 sec. 127;[15]

In Europe:

- Directive 2009/35/EC for colouring matters added to medical products;[16]

In the USA:

- Federal Food, Drug, and Cosmetic Act (FD&C Act), Amendment 2023, 21 CFR 74(A)(B) [17]

Regarding the cosmetic industry the following regulations are referred –

In India:

- Drug and Cosmetic Act, 1945
- Section 134, Specified by BIS (IS: 4707 part 1 amendment) and Schedule Q;[18]

In Europe:

- Directive 76/768/EC which has been replaced by Regulation (EC) No. 1223/2009, Annex IV;[19]

In the USA:

- Federal Food, Drug, and Cosmetic Act (FD&C Act), Amendment 2023, 21 CFR 74(A)(C).[20]

The following Table 1 shows the commonly used AFCs in the consumer food market, their health risks and sanctions regarding food, drug and cosmetic industries in India, Europe and the USA.[21-37] The table has been prepared by referring to the above listed legislations.

Health concerns may be given its due from a lifestyle behaviour, because of genetic make- up, exposure to pollution, other toxic substances, and majorly food adulteration. Such risks shall lead to allergies, asthma, low birth rate, psychological complications, heart disease, hyperactivity among children, etc. These health issues encompass fluctuations in thyroid hormone levels, impacts on learning and memory, damage to DNA, and potential carcinogenic consequences. The study underscores the importance of monitoring the usage of synthetic food colourants to mitigate health risks and protect individuals from adverse effects on their well-being.[38] In a surprising twist, USA food manufacturers allow many food additives which are banned in other parts of the world. These additives cause health risks like cancers, reduced fertility and directly damage DNA. Potassium bromate and brominated vegetable oil are banned in Europe, India, and Japan yet it is still legal in the USA. However, many food colours are not banned in Europe or the USA, where the European authorities are requiring to include a warning label

that details the potential risks associated with the dyes.[39] The United States' lax law framework for food additives, highlights flaws in the Food and Drug Administration's (FDA) approval process, including the voluntary nature of safety submissions and the withdrawal of requests after FDA concerns are raised. This flawed system allows for the widespread use of potentially harmful additives without proper review, putting consumers at risk, particularly vulnerable populations such as children and pregnant women. The author suggests that the FDA needs to prioritize consumer safety over economic interests and strengthen regulations to better protect public health.[40] It is revealed that FSSAI permits only eight AFCs to be used in the food, drugs and cosmetics in India. Overall, it is observed from the above Table 1 that, India has fared better in terms of approval of colour usage in the food, drug and cosmetic industries and being sensitive towards the well-being of its citizens when compared to the USA and Europe. This is a bold leap forward since Indian citizens are more inclined towards colours for every occasion and untying those roots through a legal process is worth commending. India and the USA have separate laws and regulations for food, drugs and cosmetics, but in Europe, it is a self-regulating authority.

Table 1: A Comparative Chart of USA, Europe and India Regarding Food, Drug and Cosmetic Industries

No.	Colours and Health Risks	Country	Industry		
			Food	Drug	Cosmetic
1	Quinoline yellow - hyperactivity in children and has the lowest side effects among artificial colours	India	x	√	√
		Europe	√	√	√
		USA	x	√	√
2	Tartrazine - Asthma, nitrous derivate, gastrointestinal, and urticaria. High usage of tartrazine causes a risk of primary biliary cirrhosis in postmenopausal women.	India	√	√	√
		Europe	√	√	√
		USA	√	√	√
3	Sunset Yellow FCF - Hives, nasal congestion, allergies, hyperactivity, headaches, damaged body cells, kidney tumours, and DNA damage	India	√	√	√
		Europe	√	√	√
		USA	√	√	√
4	Azorubin - Infertility, irregular menstruation, and hormonal disturbances	India	x	x	x
		Europe	√	√	√
		USA	x	x	x
5	Amaranth - Kidney issues, swollen throat and mouth, diarrhoea, ulcers.	India	x	x	x
		Europe	√	√	√
		USA	x	x	x
6	Ponceau 4R - There is no indication of arcinogenesis, mutagenic, neurotoxic, fertility, or developmental toxicity.	India	√	√	x
		Europe	√	√	√
		USA	x	x	x
7	Erythrosine- Thyroid tumours	India	√	√	√
		Europe	√	√	√
		USA	√	√	x
8	Allura red AC - Cancer, food intolerance, attention deficit hyperactivity disorder, cardiac disease, brain damage, nausea, and asthma	India	x	x	x
		Europe	√	√	√
		USA	√	√	√
9	Patent Blue - Patent Blue did not show any mutagenic ctivity. It causes damage to the DNA, reducing the values of hemoglobin and red blood cells.	India	√	x	√
		Europe	√	√	√
		USA	x	x	x
10	Indigo Carmine - hives, swelling of the tongue, breathing difficulty	India	√	√	√
		Europe	√	√	√

		USA	√	√	x
11	Orange B - There is no evidence for genotoxicity, carcinogenicity, and hypersensitivity	India	x	x	x
		Europe	x	x	x
		USA	√	x	x
12	Brilliant Blue FCF - cancer, tumours, hyperactivity and asthma	India	√	√	√
		Europe	√	√	√
		USA	√	√	√
13	Green S - Increased caecal weight, protein casts, urinary protein, thyroid degeneration in females.	India	x	x	x
		Europe	√	√	√
		USA	x	x	x
14	Fast Green FCF - Tumours, irritation of the skin, eyes, respiratory and digestive tract	India	√	√	√
		Europe	x	x	x
		USA	√	√	√
15	Caramel -Genotoxicity, carcinogenicity, toxicokinetic, and reproductive toxicity	India	√	√	x
		Europe	√	√	√
		USA	x	x	x
16	Rhodamine B - carcinogenicity, toxicity, reproductive, acute toxicity, and neurotoxicity.	India	x	x	√
		Europe	x	x	x
		USA	x	x	x
17	Metanil Yellow -It causes hepatotoxic and neurotoxicity.	India	x	x	x
		Europe	x	x	x
		USA	x	x	x

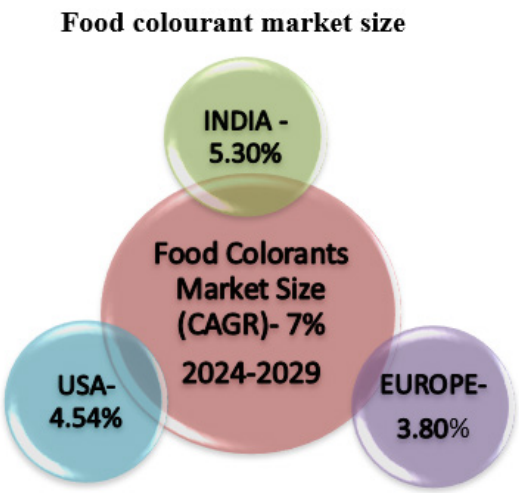


Fig.1: Growth of Food Colourant Market size

Figure 1 depicts the anticipated Compound Annual Growth Rate (CAGR) for the food colorants market size from 2024 to 2029 in the following three different countries: India, the USA, and Europe. India is forecasted to have the highest growth rate, with a CAGR of 5.30%. The United States follows closely, with a projected CAGR of 4.54%. Europe is expected to increase at a rate of 3.80%. India has been exporting more food colours to China, the USA, Brazil, Indonesia, Italy, and Mexico. Between 2014 and 2019, the export market sizes increased from 203 to 263 million. This suggests that there is a huge food colouring export business from India to different countries around the world. India imports large artificial food colours from China, the Netherlands, Denmark, Spain, Germany, Italy, and Peru.[41]

The International Regulations Pertaining to Food Safety Standards

The international organizations responsible for regulating global food standards include the Codex Alimentarius Commission (CAC). This intergovernmental organization was established by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO). These are responsible for formulating worldwide food standards, including developing nations like India.[42] In the modern marketing age, there are many regulations to control the usage of poisonous chemicals in cosmetics, food, and drugs. The first food colouring regulation in 1906 'The Pure Food and Drugs Act' was formed by America to protect the American people. Improving the 1906 Act they formed a new regulation in 1927 Food and Drugs Administration (FDA), which banned many colours used in foods and drugs to prevent the consumer from the toxicity of chemicals. In recent years, the USA and Canada reduced the practice of synthetic colours in foods

and drugs, because the usage of synthetic colours puts lives at risk, especially children. The European Food Safety Authority (EFSA) was formed on 21st February 2002. The European government formed it to avoid using harmful chemicals in foods and drugs. Under the EFSA there are more than eight food authorities, from eight different countries. Even EFSA-approved colours are banned by the FSSAI in India and FDA in the USA. A further investigation into the information on food colourant practices and the regulatory provisions under FSSAI, Bureau of Indian Standards (BIS) and Prevention of Food Adulteration Act (PFAA) in India are studied.

Permitted Artificial Food Colours

The AFCs discussed here are derived from the regulations set forth by the FSSAI. These regulations provide guidance and authorisation for the use of specific food colours ensuring compliance with safety and quality standards.[12] Food colours coded with unique numbers (0-199) are suffixed with INS, where at present eight AFCs are permitted by FSSAI.

The International Numbering System (INS) is a worldwide recognized system used to identify food additives, including food colours. The INS assigns a unique numerical code to each approved additive, facilitating international trade and ensuring transparency in food labelling. Food colours are identified by INS numbers, which indicate their specific chemical composition and function in food products. These numbers are used by the CAC along with FAO and WHO. This system helps regulators, manufacturers, and consumers easily identify and understand the additives present in the food they consume, promoting food safety and transparency in the food industry.

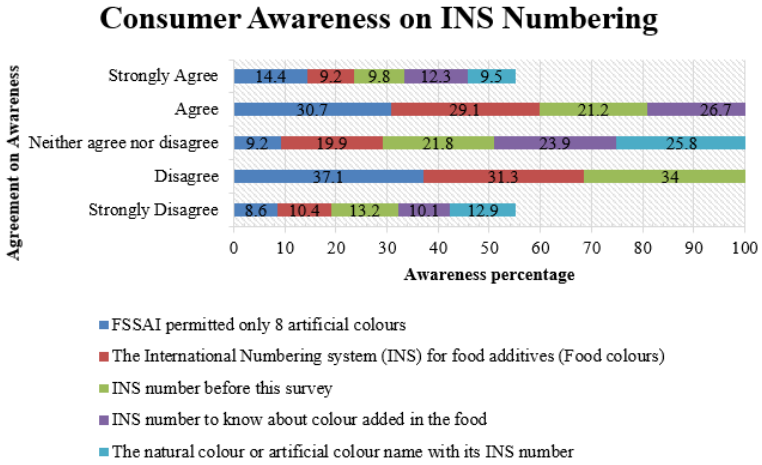
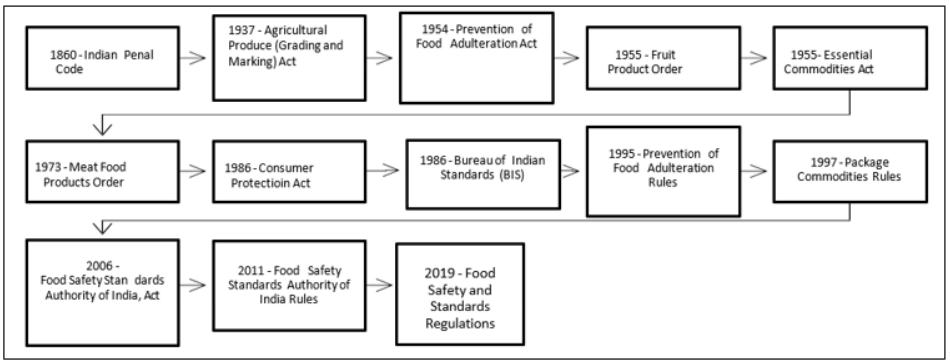


Fig.2: Consumer awareness of the INS numbering

The inferences drawn from Figure 2 indicate that 30.7% of the respondents were aware that the FSSAI permitted only eight colours. However, the majority, constituting 34% of the respondents, did not know the INS number before this survey. Only a small fraction, 9.2%, were fully aware of the INS numbering system. Additionally, 9.5% of the respondents were able to associate the natural or artificial colour name with its corresponding INS number.

Researchers surveyed to assess the knowledge of Indian consumers regarding the International Numbering System (INS) for food additives, specifically food colours. The findings suggest that consumers require further education and heightened awareness about INS numbers and food additives. Consumers must understand the implications of these additives in their food. Therefore, manufacturers should take the responsibility of providing clear information about these additives on their product labels. This transparency will empower consumers to make informed decisions about the food they consume. To enhance consumer understanding, educational campaigns could be implemented by the government. These campaigns could focus on explaining the INS system, the types of food additives, and their potential effects on health. Additionally, manufacturers could improve

their product labelling by using layman-friendly terms alongside INS numbers, or providing a brief description of each additive, and highlighting the purpose of its inclusion in the product. The included colours with INS are discussed below.



Source: Compiled by the author

Fig.3: Food Safety Regulation in India

Erythrosine

It is red in colour. According to FSSAI regulation chapter 3.2.1, it is allowed to be used in the powdered soft drink, fruit beverage drinks, jelly, candies, wafers, flavour paste to 100 ppm (part per million) maximum but in synthetic syrups, carbonated fruits, and water soft drinks, fruit-based beverages FSSAI permits to use 200ppm maximum. It is mentioned on the package labels as INS 127.

Brilliant Blue FCF

It is blue in colour. According to FSSAI regulation chapter 3.2.1, it is used in bread, biscuits, chocolates, cocoa powder, sugar-boiled candies, bubble gums, and ice creams with 100 ppm maximum; and in synthetic syrups, carbonated fruits, and water soft drinks, fruit-based beverages FSSAI permits to use 200 ppm maximum. It is mentioned on the package labels as INS 133.

Fast Green FCF

It is green in colour. According to FSSAI regulation chapter 3.2.1, it is used in biscuits, candies, flavour emulsion, chocolates, sugar-boiled candies up to 100 ppm maximum; and synthetic syrups, fruit-based beverages, powdered fruit-based beverages FSSAI permits to use 200 ppm maximum. It is mentioned on the package labels as INS 143.

Azorubine

It is commonly called Carmoisine and is dark red in colour. It is permitted by the FSSAI according to regulation chapter 3.2.1, to be used in cookies, concentrated fruit drinks, and wafers to a maximum of 100 ppm. It is used in thermally processed vegetables up to 200 ppm maximum. This is mentioned on the package labels as INS 122.

Tartrazine

It is a synthetic lemon yellowish food colour and is widely used in dairy products, turmeric, baked food products, chips, etc. According to FSSAI regulation, chapter 3.2.1 restricts in the use of food additives in foods such as soft drink mix, fruit beverages, custard powder, wafers, thread candies, and jelly to 100 ppm maximum. Further, it is used in cosmetic products. This is mentioned on the labels as INS 102.

Indigo Carmine

Indigo Blue or Saxon Blue or Indigo Carmine [43] is used for commercial synthesis and also in food during the 19th century. Before that, dyes were used as textile dyes, but now it is an approved colour in India by the FSSAI, according to chapter 3.2.1 allows use in bread, biscuits, soft drinks, candies, wafers, jelly crystal to 100 ppm maximum; and upto 200 ppm can be used in synthetic syrups for dispensers and is mentioned as INS 132 on the product's label.

Ponceau 4R

Ponceau 4R is the red synthetic azo dye used in colouring foods like meats, fruits, vegetables, desserts, and beverages.[28] According to the FSSAI regulation, chapter 3.2.1 agreed to this colour usage

in the food with a restricted amount of usage for non-specified food which is 100 ppm. The usage of Ponceau 4R can be made available in frozen shrimps with 30mg/kg in case of maximum cooked mass, in yoghurt it should not exceed 100 ppm and in ice creams and other dairy products, it is permitted for use up to 100 mg/kg; and upto 200 ppm can be used in synthetic syrups for dispensers. This is mentioned on the pack as INS 124.

Sunset Yellow FCF

Sunset Yellow FCF (C.I. 15985) is the orange-yellow colour which is being used in beverages, desserts, cheeses, sauces, and other food items. This colour is not only used in food items but also used in personal care products, drugs, and cosmetics. Sunset Yellow FCF was assessed by the 'Scientific Committee on Food' (SCF) in 1984, and an Acceptable Daily Intake (ADI) of 0- 0.25mg/kg body weight was established.[21] According to FSSAI regulation, chapter 3.2.1 restricted the usage of this colour in soft drinks, custard powder, thread candies, jelly crystal, and fruit beverages to 100 ppm maximum. In seafood such as fish and canned shrimps, this colour is used to the maximum limit of 30 mg/kg. As far as fruits (Plums) and vegetables such as beans and sweet corn are concerned, a maximum of 200 ppm can be used. This is mentioned on the pack as INS 125.

Non-Permitted Artificial Food Colours under FSSAI, but approved by BIS

Quinoline Yellow

An alcohol soluble, and marked as (C.I. 47000) is used for alcohol paints, wax, cosmetics, and drugs and Sulfonated dye (C.I. 47005); to decorate food items and coat foods.[44] This colour is not allowed in India to be used in food but is allowed in cosmetics since it is approved by the BIS.

Non-Permitted Artificial Food Colours under FSSAI, BIS And PFAA

Rhodamine B

It is a bright and strong red Fluorescent dye and is not permitted in India. It is banned as per PFAA in 1954 by the Indian Government. Even though Rhodamine B is not permitted by the food authority it is used in food and drugs, especially in the cotton candies for pink colour; and not permitted to be used in cosmetics also in India.[45]

Metanil Yellow

An azo dye and dark yellow dye used as food colouring and banned as per PFAA 1954, by the Government of India. Products such as turmeric, dals, sweets, and candies are found to have Metanil yellow as a food colourant. In India, people from Gujarat, still consume more Metanil yellow in food and sweets when compared with other states.[46]

Amaranth: Amaranth is a synthetic dye, before 1974 it was used as food dye but in 1974 it got banned in India.

Allura Red AC

Basically, this colour is used in tattoo ink, children's medicine, and flavoured foods Allura Red AC is now getting replaced by Amaranth. This colour is banned in India.

Patent Blue V

It is sky-blue in colour and banned in India. It is mostly found in jelly sweets, Scotch eggs, and medicine.

Orange B

this colour belongs to an azo dye group and is completely banned in India.

Green S

It is a dark green synthetic coal tar. It is used in mint sauces, mint gravy, desserts, sweets, ice creams, and tinned peas. This colour is prohibited from being used in India.

How India has fared in the Food Safety Standards

In the modern marketing age, there are many regulations to control the usage of poisonous chemicals in cosmetics, food, and drugs. In India, to prevent lethal chemicals from being used in the food, it started the PFAA in 1954 and by improving this Act, the FSSAI was enacted in 2011 by the Ministry of Health and Family Welfare, Government of India and established under the Food Safety and Standards Act (FSSA), 2006. These have been formed to prevent food products' decline in terms of standards and additives, packing, labelling, contaminants and toxicity. Figure 3 projects the growth of food safety regulations in India.

An Overview of Judicial Decisions Concerning the Adulteration of Food Due to the Existence of Non-Permitted Food Colourants

The response from the Indian judiciary on various occasions of cases filed have been considered, where the most prominent cases filed regarding the practice of prohibited food colourants in the Indian market have been cited and the legal concerns involving their decisions have been debated. Post the ginger bottle case (Donoghue vs. Stevenson), some of the note-worthy cases regarding the usage of non-permitted food colourants in the Indian market, dealt under the PFAA, 1954 read along with Prevention of Food Adulteration Rules (PFAR) 1955, the FSSAI under the FSSA 2006, Section 272 of the Indian Penal Code (IPC), 1860 and the peoples' right to health as provided under the Indian Constitution under Article 21 against the hazardous nature and injurious food articles, questioning the duty of the state to ensure such rights are protected under Article,[47] are enumerated in the Table 2 below. All these laws are to regulate the science-based standards for food and manufacturing, packaging, storing, distributing, importing and selling to assure the quality of food.

Table 2: Judicial Response on the prevalence of non-permitted food colours in the market

No.	Case Laws	Observations
1	The Food Inspector, Notified Area Council vs. Laxminarayan[47]	"Arhar Dal was found adulterated with Metanil Yellow on analytical testing, when the responsible testimony purchased a sample. The accused was found guilty."
2	State vs. Chelliah Pillai and Ors.[48]	"Metanil Yellow is a forbidden type of chemical dye under Rule 28 of the Food Adulteration Rules, and thus the issue of data variations didn't emerge and had no impact. Permitting the appeal, the learned Magistrate's judgment of acquittal was set aside, and the defendants were found guilty."
3	Food Inspector, Pondicherry vs. T.S. Subramania Iyer and Ors.[49]	"The sample was drawn and sent to the Public Analyst without being kept in ice or other refrigerators. After receiving the sample, the evaluation was two days late in assessing. This was considered a delay in interpretation, and the Public Analyst had not specified in his assessment what was the condition of rose milk. Appeal denied and acquitted."
4	State of Assam vs. Bhawarilal Kundalia and Ors. [50]	"The accused might be sentenced based on evidence. By 'data', this was meant a result from which it might be determined whether such a product was adulterated or not. A declaration of the results of an analysis of the sample in the existence of Metanil Yellow would be data from which it can be concluded that Arhar Dahl was adulterated. So, data in the existence of Metanil yellow was mostly present in the report, which was considered sufficient to find guilt."
5	State of Gujarat vs. Gangaram Khanmal Sindhi [51]	Quoting that "Ignorance of the nature of adulterated food is no excuse, substance or quality of food sold would not be prejudiced by the sale. Care is required to be taken by vendors for the food articles". Found guilty and convicted of selling adulterated peppermints with non-permitted Rhodamine B coal tar.
6	State vs. Lal Chand Agarwal[52]	"As the manufacturer is the maker of biscuits, primarily the prosecution failed to establish beyond a reasonable question that the manufacturer of biscuits was indeed making the lozenges with the non-permitted colour Rhodamine B and Orange II for human consumption; Secondly, the prosecution

		should have demonstrated that the polythene bags in which the sample was collected were fresh and sterilised. Hence, the benefit of the doubt went in the accused's favour."
7	Kewal Krishan vs. State of H.P.[53]	"Delay due to gross negligence in proving the accused for the sale of adulterated ice-candy, hence held proving petitions of governing authority was not an adequate stipulation or compliance in law."
8	Ramesh Chandra Srivastava vs. State of U.P. and Ors.[54]	"Artificial flavouring of candies intended for children's use and consumption accused was found guilty of adulterating sweets, and the prosecution's case was proven beyond a reasonable doubt."
9.	U.T. Chandigarh vs. Ashok Kumar and Ors.[55]	"The food article in this case is 'patisa' which falls in the category of 'sweets'. This food article is not standardized and does not fall into any of the specified categories as per Appendix-B of PFA Rules. The accused deserves to be given the benefit of the doubt since the material is not sufficient to conclude that the accused sold a misbranded food article (containing Tartrazine) in violation of section 2(ix)(e) of PFA Act by making some false claim. Also, there is the absence of clinching evidence that the notice was duly served upon the accused. The accused is acquitted of the charges."
10	Narayana Prasad Sahu vs. The State of Madhya Pradesh.[56]	"Though the accused has committed the crime of adulterating the chana daal as per the Public Analyst, the report from the Public Analyst could not be delivered to the accused on various occasions and was returned by the postman. The court observed that 'mere dispatch of the report to the accused is not a sufficient compliance with the requirement of Sub-section (2) of Section 13 of the Act and the report must be served on the accused' thereby acquitting the accused."
11	Prawar Goyal and Anr. vs. State of Madhya Pradesh and Anr.[57]	"Where the accused has used 'non-edible golden offset colour' to polish the wheat, and the apex court has observed and stated that 'Only in India we are liberal with the health concerns', refusing to entertain the pre- arrest bail pleas."

The above judgements make it clear that the plight of the health of the people of India is still at stake, citing various legal ambiguities. Though the consumer protection laws have undergone sea transformations giving scope for consumers to fight for their rights, the role of government has grown in leaps and bounds by taking up its constitutional duty through food inspectors tasking and towing the marketing world to the court of law. The judiciary has also acted appropriately keeping in view the PFAA and its rules which had to accede to the gaps in the laws considering them as legal compliance. The FSSA, 2006 lacks in not addressing the unorganised sectors, which takes into account manufacturers, street hawkers, and retailers who contribute a lot to the unorganised sector economy, rather has laid emphases on the processing industry. Whether such gaps need a continued existence, or may be given a secondary importance when guilt is found prima facie, has to be considered by the esteemed courts.

Results and Findings

The demand for the consumption of colours increased, which depleted the availability of naturally extracted colours and paved the way for other sources of colour availability, especially artificial to keep up with the growing demands. The industrial age witnessed the large manufacturing and usage of AFCs in cosmetics, drugs, and textiles other than food, due to their low cost, attraction towards more colour combinations, ease of manufacture and availability; in the process, it was failed to be

recognized by the stakeholders that it is perilous to both humans and the environment at large. In India, other than the constitutional rights, sufficient regulations have budded to protect the consumers from consuming harmful chemicals not only as a constitutional right towards healthy and safe food but also making it a crime under Indian IPC, now Bharatiya Nyaya Sanhita (BNS), 2023. Other statutory provisions directly considering the safety of food are the PFAA and FSSA. The Consumer Protection laws provide remedies to the consumers upon bringing such instances to the forum. By examining the statutory provisions, it is found that one colour, i.e., fast green FCF colour, caramel, erythrosine, are some colours that need attention to be prohibited in India due to their serious health hazards. These colours are already banned in countries such as Europe, the USA and China. These colours are permitted in India as the legislation does not cover them. Colours such as Rhodamine B and Metanil Yellow colours are prohibited and banned by the Indian government in use for food, drugs and cosmetics, although they are still largely found in the FMCG sector, especially the food industry, for main reasons such as attractiveness and identification purposes, where only eight artificial colours, permitted by the Indian government under FSSAI are to be used. Moreover, it is observed that the packaging and labelling process of certain products involves the mentioning of colour codes, which the common man is not educated upon, hence the decision-making while purchasing gets biased and advantageous to the seller. A good number of cases are decided against the usage of non-permitted colours in food as well as in cosmetics. The judiciary has come to the rescue of the consumers positively based on the evidence, and such colours have been condemned to be further used by the food market. In some instances, due to lack of evidence and other weak laws, cases have been dismissed.

Suggestions and Conclusion

From the 19th century, an enormous growth in the application of colours took place in the food industry, especially during the industrialization period. Post industrialization many health issues have emerged due to the food industry taking a storm towards consumer attraction while inducing them to purchase based on colour impression. Science and technology have rescued marketers from the transient phase of natural to synthetic food colourants; natural colourants becoming less available and an expensive process gave scope for artificial colours to dominate the market. These colours create an impact on the local and unorganised markets as they form the major source of economic support at various levels.

To reduce the usage of harsh chemicals in food, the FDA, EFSA, and FSSAI have come to the rescue of the stakeholders concerning import - export of food products associated with the territory of India, yet many cases of use of banned food colour, using colours beyond permissible limits are emerging. This study has not addressed the policy issues related to the import of food, containing artificial food colourants that are permitted in the USA, Europe and other countries, but banned in India. In India, primarily, food adulteration is a crime under IPC and is punishable with a fine of rupees one thousand (now under BNS, Section 274-276 as a non-cognizable offence with a fine of 5000 rupees) and imprisonment of six months. Since this is a crime, the benefit of the doubt plays a significant role in favour of the accused. Is the offence so trivial that a meagre five thousand rupees will suffice to justify one's guilt with a puny punishment of six months imprisonment? The BNS Act, 2023 has not given much weightage to food adulteration punishments. A deep look into the good health of the future citizens of this country may pave the way for brighter and stronger laws in fulfilling the constitutional rights, duties and Directive Principles of State Policy (DPSP). Examining Article 39, which provides that the State shall direct its policy towards ensuring that Indian citizens of all genders are treated equally; having the right to suitable and adequate means of livelihood. Certainly, food is not just a means of livelihood but is necessitated for survival. Another important article that needs to be concentrated is 47. It provides that the State shall upgrade the standards of nutrition and living of its people; and improve the public health as the prime duties. Considering the federal nature of the Indian Constitution which is in congruence with the fundamental rights and DPSP, List III-Entry 33 of Schedule 7, inter-alia provides for the distribution and supply of foodstuff. Here the legislation can be passed by the Union and equally also by the State. Thus, it can be construed that the basis for the 'right to safe food' from the Constitution can be derived from a combination of the right to food, protection of life, health, sustenance, adequate nutrition and public health, among others.

It is also the consumers' responsibility to be educated and to avoid purchasing those products containing banned food dyes. Having a wide awareness of the regulations, including packaging and labelling of food products by the manufacturers and sellers, so that informed and voluntary consent of the consumer will parallel the liability of the seller and manufacturer. The purpose of mentioning the ingredients on a product package should not be mainly for legal purposes but also give weightage to it being consumer friendly and that they know more about the product for an appropriate decision making to purchase; giving more scope to the doctrine of caveat emptor, further avoiding the clutter in the court case applications. Equally important would be, to have repeated education to the public in English and vernacular languages via., audio and visual advertisements on radio and television and campaigns to the consumers on what is right to eat, what ingredients are more suitable, what contents must be mentioned on a package of a product and are they mentioned correctly, if not bring it to the notice of the concerned company, further filing complaint with the consumer forums. Paralleling the seller's liability with the buyer's responsibility will bring down unwanted and exaggerated food products, thereby enhancing and improving the market environment holistically.

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Conflict of Interest

The authors declare no conflict of interest.

Authors' Contribution

Conceptualisation, US; formal analysis, US and JPR; hypotheses development and data collection, JPR; methodology and data analysis, US and JPR; supervision, US. All authors read and agreed to the final version of the manuscript.

Data Availability

Data will be made available upon the reasonable request to the corresponding author.

Ethics approval

The research obtained approval from the Institutional Ethical Committee for Studies on Human Subjects (IECH) with Ref. No. VIT/IECH/XIII/2023/09. All participants provided their consent to use their data for research purposes.

References

1. Groote De H., Kimenju S. C. Comparing consumer preferences for color and nutritional quality in maize: Application of a semi-double-bound logistic model on urban consumers in Kenya. *Food policy.* 2008;33(4):362-370.
2. Velasco C., Escobar F. B., Spence C., Olier J. S. The taste of colours. *Food Qual Prefer.* 2023;112:105009 https://doi.org/10.1016/j.foodqual.2023.105009
3. Beneke J., Mathews O., Munthree T., Pillay K. The role of package colour in influencing purchase intent of bottled water. *J. Res. Mark. Entrep*. 2015;17(2):165- 192.
4. Garber Jr. L. L., Hyatt E. M., Boya Ü. Ö. Does visual package clutter obscure the communicability of food package shape? *J. Food Prod. Mark*. 2008;14(4):21-32.
5. Annette M., Stafford L. D. How colour influences taste perception in adult picky eaters. *Food Qual Prefer.* 2023;105:104763. https://doi.org/10.1016/j.foodqual.2022.104763
6. Garber Jr. L. L., Hyatt E. M., Nafees. The effects of food color on perceived flavor: a factorial investigation in India. *J. Food Prod. Mark*. 2016;22(8):930-948.
7. Bhatti K. K., Fatima F. Colour: The Mantra for Marketing. Int. J. Adv. Eng. Manag. Sci. 2016;2(6):881-885.

8. Chandra Lal R., Yambrach F., McProud L. Consumer perceptions towards package designs: A cross cultural study. *J. Appl. Packag. Res.* 2015;7(2):61-94.
9. Huang L., Lu J. The impact of package color and the nutrition content labels on the perception of food healthiness and purchase intention. *J. Food Prod. Mark.* 2016;22(2):191-218.
10. Velasco C., Obrist M., Petit O., Spence C. Multisensory technology for flavor augmentation: a mini review. *Front. Psychol.* 2018;9:26. https://doi.org/10.3389/fpsyg.2018.00026
11. Comrey A. L., & Lee H. B. A first course in factor analysis. In Comrey A. L, Lee H. B. Interpretation and application of factor analytic results. 2nd edition. New York: *Psychology Press,* 1992.
12. FSSAI India. Food Safety and Standards (Food Products Standards and Food Additives Regulation, https://www.fssai.gov.in/upload/uploadfiles/files/Food_Additives_Regulations.pdf 2011; Accessed on 15 Nov 2023.
13. Regulation (EU) No 231/2012 of 9 March 2012 laying down specifications for food additives listed in Annexes II and III to Regulation (EC) No 1333/2008 of the European Parliament and of the Council Text with EEA relevance. OJ L.2012;01–295. http://data.europa.eu/eli/reg/2012/231/oj Accessed on 15 Nov 2023.
14. Federal Food, Drug, and Cosmetic Act (FD&C Act), amendment 2023, 21 CFR 74(A)(A). https://www.ecfr.gov/current/title-21/chapter-I/subchapter-A/part-74?toc=1 2023; Accessed on 17 Nov 2023.
15. Drug and Cosmetic Act, 1945 sec. 127. https://cdsco.gov.in/opencms/export/sites/CDSCO_WEB/Pdf-documents/acts_rules/2016DrugsandCosmeticsAct1940Rules1945.pdf 1945; Accessed on 16 Nov 2023.
16. Directive 2009/35/EC of the European Parliament and of the Council of 23 April 2009 on the colouring matters which may be added to medicinal products. *OJL.* 2009;109:10–13. http://data.europa.eu/eli/dir/2009/35/oj 2009; Accessed on 15 Nov 2023.
17. Federal Food, Drug, and Cosmetic Act (FD&C Act), amendment 2023, 21 CFR 74(A)(B). https://www.ecfr.gov/current/title-21/chapter-I/subchapter-A/part-74?toc=1 2023; Accessed on 17 Nov 2023.
18. Drug and Cosmetic Act, 1945. Section 134, Specified by BIS (IS: 4707 part 1 as amendment) and Schedule Q. https://cdsco.gov.in/opencms/export/sites/CDSCO_WEB/Pdf-documents/acts_rules/2016DrugsandCosmeticsAct1940Rules1945.pdf 1945; Accessed on 16 Nov 2023.
19. Regulation (EC) No 1223/2009 of the European Parliament and of the Council of 30 November 2009 on cosmetic products. *OJL.* 2009;342:59–209. http://data.europa.eu/eli/reg/2009/1223/oj 2009; Accessed on 18 Nov 2023.
20. Federal Food, Drug, and Cosmetic Act (FD&C Act), amendment 2023, 21 CFR 74(A)(C). https://www.ecfr.gov/current/title-21/chapter-I/subchapter-A/part-74?toc=1 2023; Accessed on 17 Nov 2023.
21. Abbey J., Fields B., O'Mullane M., Tomaska L.D. Food Additives: Colorants. In: Motarjemi Y. Encyclopedia of Food Safety. Vol 2 Hazards and Diseases. London: Elesiver; 2014:459-465.
22. Axon A., May F. E., Gaughan L. E., Williams F. M., Blain P. G., Wright M. C. Tartrazine and sunset yellow are xenoestrogens in a new screening assay to identify modulators of human oestrogen receptor transcriptional activity. *Toxicology.* 2012;298(1-3):40-51.
23. Ahmed M. A., Al-Khalifa A S., Al-Nouri D. M., El-din M. F. Average daily intake of artificially food color additives by school children in Saudi Arabia. *J. King Saud Univ. Sci.* 2023;35(4):102596. https://doi.org/10.1016/j.jksus.2023.102596
24. Kobylewski S., Jacobson M. F. Food dyes: A rainbow of risks. Center for Science in the Public Interest. https://www.cspinet.org/sites/default/files/attachment/food-dyes-rainbow-of-risks.pdf 2010; Accessed on 26 Aug 2023.
25. Mota I. G., Neves R. A., Nascimento S. S., Maciel B. L., Morais A. H., Passos T. S. Artificial dyes: Health risks and the need for revision of international regulations. *Food Rev. Int.* 2023;39(3):1578-1593.
26. Amin M. A. Pathophysiological effect of Azorubine on female reproductive organs and hormones in Sprague Dawley rats. *IJMRHS.* 2018;7(6):57-62.

27. Joshi D. C., Sood S., Hosahatti R., Kant L., Pattanayak A., Kumar A., Yadav D., Stetter M. G. From zero to hero: the past, present and future of grain amaranth breeding. *Theor. Appl. Genet.* 2018;131:1807-1823.
28. Bell, B. "Are artificial food dyes safe? EcoWatch," https://www.ecowatch.com/food-dyes-harmful-2196266446.html 2017; Accessed on 04 Aug 2023.
29. Rovina K., Siddiquee S., Shaarani S. M. Extraction, analytical and advanced methods for detection of allura red AC (E129) in food and beverages products. *Front. Microbiol.* 2016;7:798. https://doi.org/10.3389/fmicb.2016.00798
30. EFSA Panel on Food Additives and Nutrient Sources added to Food. Guidance for submission for food additive evaluations. *EFSA Jour.* 2012;10(7):2760.
31. John P.C., DO, FACOEP. INDIGO CARMINE. RxList. https://www.rxlist.com/indigo-carmine-side-effects-drug-center.htm 2021; Accessed on 05 Sep 2023.
32. Gilani R., Joshi S., Shankari V.S., Joshna P.M., Rao V. Effect of Brilliant Blue FCF Food Colour on Plant and Human DNA. *IJMG.* 2017;8:01-10.
33. Alex. Additives Most Likely to Cause Adverse Reactions. Food Additive Numbers List & Effects. *Check Labels.* https://checklabels.com.au/additives-most-likely-to-cause-adverse-reactions/#comments 2018; Accessed on 04 Sep 2023.
34. Liu F., Wang W., Xuan Z., Jiang L., Chen B., Dong Q., Zhao F., Cui W., Li L., Lu F. Fast green FCF inhibits Aβ fibrillogenesis, disintegrates mature fibrils, reduces the cytotoxicity, and attenuates Aβ-induced cognitive impairment in mice. *International J. Biol. Macromol*. 2021;170:33-41.
35. Vollmuth T. A. Caramel color safety–an update. *Food Chem. Toxicol.* 2018;111:578-596.
36. Sharma G., Naushad M., Kumar A., Kumar A., Ahamad T., Stadler F. J. Facile fabrication of chitosan-cl-poly (AA)/ZrPO4 nanocomposite for remediation of rhodamine B and antimicrobial activity. *J. King Saud Univ. Sci.* 2020;32(2):1359-1365.
37. Rahman M. A., Bala A. K., Rahman M. A., Hasan M. K., Masuma R. Neuropharmacological and gastrointestinal evaluation of coloring agent metanil yellow used in food and beverages. Jahangirnagar University *J. Biol. Sci.* 2019;8(1):35-44.
38. Jananipriya R., Usha S. A critical review of the food colourants effects on Human Health and Environment. *Res. J. Biotechnol.* 2023;18(10):249-254.
39. Morrison C. 10 hazardous food additives that are banned in Europe but completely legal in the US — including suspected carcinogens and chemicals linked to low sperm counts. Mail Online. https://www.dailymail.co.uk/health/article-11777037/The-risky-food-additives-banned-Europe-legal-US.html 2023; Accessed on 20 Mar 2024.
40. Vivekanandan N. Spilling the Beans: Food Additive Regulations in the United States Pose Serious Health Risks. *JHBL.* https://sites.suffolk.edu/jhbl/2022/10/31/spilling-the-beans-food-additive-regulations-in-the-united-states-pose-serious-health-risks/ 2022; Accessed on 20 Mar 2024.
41. CATR Product profile: food colouring agents. Trade Promotion Council of India. https://www.tpci.in/indiabusinesstrade/blogs/product-profile-food-colouring-agents/ 2019; Accessed on 13 Feb 2024.
42. Varghese R., Ramamoorthy S. Status of food colorants in India: conflicts and prospects. *JCF.* 2023;18(2):107-118.
43. de Keijzer M., van Bommel M. R., Keijzer R. H., Knaller R., Oberhumer E. Indigo carmine: understanding a problematic blue dye. *Stud Conserv*. 2012;57(sup1):S87-95.
44. Berneth H. Methine dyes and pigments. In: Ley C. Ullmann's Encyclopedia of Industrial Chemistry. Weinheim: Wiley-VCH; 2008. https://doi.org/10.1002/14356007.a16_487.pub2
45. Li M., Li Y., Wang X., Cui X., Wang T. Synthesis and application of near-infrared substituted rhodamines. *Chin Chem Lett.* 2019;30(10):1682-1688.
46. Kourani K., Kapoor N., Badiye A., Shukla R. K. Detection of synthetic food color "Metanil yellow" in sweets: A systematic approach. *J. Planar Chromatogr. - Mod. TLC.* 2020;33(4):413-418.
47. The Food Inspector, Notified Area Council vs. Laxminarayan (27.11.1969 - ORIHC): MANU/

OR/0195/1969
48. State vs. Chelliah Pillai and Ors. (01.08.1975 - MADHC): MANU/TN/0643/1975
49. Food Inspector, Pondicherry vs. T.S. Subramania Iyer and Ors. (23.07.1981 - MADHC): MANU/TN/0012/1981.
50. State of Assam vs. Bhawarilal Kundalia and Ors. (03.01.1984 -GUHC): MANU/GH/0029/1984.
51. State of Gujarat vs. Gangaram Khanmal Sindhi (05.10.1998 - GUJHC): MANU/GJ/0364/1998.
52. State vs. Lal Chand Agarwal (29.08.2005 - ORIHC): MANU/OR/0331/2005
53. Kewal Krishan vs. State of H.P. (23.03.2011 - HPHC): MANU/HP/2949/2011.
54. Ramesh Chandra Srivastava vs. State of U.P. and Ors. (27.10.2017 - ALLHC) : MANU/UP/3108/2017.
55. U.T. Chandigarh vs. Ashok Kumar and Ors. (06.02.2019 - PHHC): MANU/PH/0143/2019
56. Narayana Prasad Sahu vs. The State of Madhya Pradesh (29.10.2021 - SC): MANU/SC/1017/2021.
57. Prawar Goyal and Anr. vs. State of Madhya Pradesh and Anr. (08.06.2021 - SC Order): MANU/SCOR/16488/2021.