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Food Color Additives Applications in Food Products, and Related Health Hazards

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ABSTRACT

Food coloring pigments are typically unstable and change throughout processing, every dye or pigments applied to food has an impact on its organoleptic qualities which directly influence customer acceptance and food choice . A lot of food types have color additives, they are crucial because they act as a sort of code that helps us recognize items at a glance. Color additives are used by manufacturers to provide, their products "added value" while concealing natural loss caused by exposure to light, air and temperature. Synthetic food coloring has become increasing popular as an addition in place of natural food coloring, with the aim of achieving certain effect such as improved appearance, intensity, color stability and consistency synthetic food colors have a number of commercially significant advantages over natural ones, including affordability resistance to light fluctuations and PH. The most accurate approach for determining color additives in meat and dairy products are to use High Performance Liquid Chromatography (HPLC) methodology .Because of their possible risks, some synthetic colorants are being replaced with ones derived from natural sources ,there have been many documented toxicities and adverse consequences, particularly when ingested in excess .As a result the Food Organization and World Health Organization have regularly determined and assessed the safety data for each synthetic food additives ,there should be stringent legal restrictions on the use of artificial colorant as food additives.

INTRODUCTION

Any ingredient that gives food or drinks color added is referred to a food color additive. Both home and professional food preparation process use food coloring. Food colorants are chemical compounds used in food technology that helps food taste better, restore colors lost during preparation, and enhance visual appeal. **(Barrows and colleagues, 2009; Coultate and Blackburn, 2018).** Color is a crucial component of food and beverages, and modern customer's consider visual aspects while choosing food products. In order to attain specific qualities, such enhance appearance, high color in-

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tensity, increased color stability and color uniformity, synthetic food coloring has been increasing popular as an additive to replace natural color in recent years **(Yang et al. 2011; Xing et al. 2012).**

Synthetic food coloring has a number of economically significant advantages over natural coloring, including low cost, great color stability, and resilience to light and PH.

Chemicals used as artificial food coloring is derived from coal tar compounds, and majority of them have an azo group. The market's assortment of meals and drinks may include both an excessive amount of approved synthetic colors and some prohibited synthetic colors. Several investigations have verified that artificial food coloring is a primary cause of food intoxication and can result in serious health issue .

Table 1 lists a number of food additives that were once widely used but are now prohibited due to evidence of their long -and medium-term toxicity, high incidence of potential health problems, and side effects **(Tripathi et al. 2007).** Like other food coloring is subjected to various laws that govern the reporting categories of food products, maximum quantities that can be used, chemical characterization, and purity (Commission Regulation (EU) No. 1129/2011.and Commission Regulation (EU) No. 2020/771).

Consequently. colorants are only allowed to be used if they fall into one of three categories having a daily intake that is defined as acceptable, or being allowed to be used only in certain circumstance.

In addition, a code consisting of the letter E (For Europe) and three or four digits is assigned to each food ingredient. The arrangement of numbers scheme adheres to the Codex Alimentarius Committee's determination of the International Numbering System (INS). Food coloring can come from natural sources, synthetic sources or both. **(Lidon and Silvestre 2010)**

The usage of synthetic colorants has been linked to health hazards, including behavioral, allergy and neurocognitive impacts. In contrast, naturally derived colorants appear to offer a relatively high quality and effective contribution as health promoter. **(Silva et al. 2022)**

Where do food colors come from?

Food coloring has been used for as long as human have existed. Natural colors like paprika, saffron, and turmeric were added to food to enhance its flavor and appearance, according to Egyptian papyri from 1500BC **(Ulrike and Arlt , 2011)**. William Henry Perkin created the first artificial organic color, mauve in 1856.

Soon after, comparable dyes were developed and were widely used to tint medications, food and cosmetic. These dyes were referred to as “coal tar colors” because they were initially made from leftovers from the processing of coal. We have used five times as many foods color additive since 1955.

Why do manufacturers use food color additives?

Color additives are used by manufacturers to restore lost color caused by exposure to light, air,or temperature changes, as well as to give their products a "added value."

Pigment type	Where it’s found	Color created
Anthocyanins	Dark-colored berries; beets	Blue-purple
Canthaxanthin	Certain fish; algae	Pink/orange
Chlorophyll	Leaves of green plants/algae	Green
Charcoal	Burned wood	Gray-black
Cochineal	Insects	Red-purple
Iron oxide	Rusting metal	Reddish brown
Paprika	Ground chili peppers	Orange-red
Saffron	Crocus flowers	Orange-yellow
Turmeric	Turmeric plant root	Bright yellow

Uses of Food Colorants:

Dairy and Ice cream:

Customers greatly value the extensive selection of dairy and ice cream colors that human offers. Dairy and ice cream manufactures utilize these hues. These hues are frequently found in water ice, processed cheese, and milkshakes, among other foods. The food items are more enjoyable because of these colors. The PH factor is taken into consideration during the sanitary preparation of these hues **(Mohamed et al. 2011).**

Meat and Delish Foods:

Human provide the food industry with flavors and meat hues. These hues are frequently seen in seasoning, fresh minced meat etc.

Food colors intensify one's hunger due to these hues.it is crucial that food coloring be heat resistant because these hues enhance the flavor of the food product. The colors are hygienic food additives **(Lone et al. 2016).**

Seafood:

people provide a hue for the application of sea food, which are utilized in smoked fish and fish coating.

The majority of the time, food agents use it. These hues are safe and true to their original state.

Additionally, it is subject to multiple rounds of expert evaluations. Fish color is primarily produced by three color pigments termed chromatophores, which are mostly found within cells **(Gan et al. 2013)**

Food coloring is available in two varieties:

1- Synthetic or artificial food coloring: also referred to as artificial generated fake food coloring ,synthetic food coloring is used to color sweets, ice cream, drinks, cold fruits, and meat items.

2- Natural food color: These are colors seen in food that are naturally occurring and come from minerals, plants, or animals. Curcumin, for instance is primarily used to color food items like sauces and drinks **(Wu et al. 2021).**

Artificial or synthetic colors:

Due to their many economically qualities, including their low cost, resilience to light, oxygen, PH, fluctuations and great color stability, food makers are using them more and more in place of natural food colors.

Unlike natural food colors, which are typically collected and refined from many natural sources, synthetic food colors are created through complete chemical synthesis or the alteration of multiple precursor chemicals.

In addition, they do not deteriorate when food is processed **(Commission Regulation, 2012).**

Artificial coloring is widely used in the form of water-soluble powder, pasts, or granulates, E160f, also known as ethyl -β-apo-8'-carotenate (ethyl ester of β-apo-8'carotenic acid), is no longer listed among the additives used in European Union products **(Commission Regulations, 2011; Commission Regulations, 2012).** The most often used artificial coloring is red food coloring(E120), which is used to tint cochineal ,an insect. Beetroot Red (E162) and green food coloring (E140) were also used, more frequently. Cochineal is made from an insect, the additives E160 b (i), E160b(ii), and E160 (iii) that were previously extracted from annatto have been substituted with the new additions E160b(i),E160b (ii)

Taking into account the significance of colorant safety restrictions in food processing **(Commission Regulations, 2020).**

Amarath (E123), Ponceau 4R(E124), Sunset yellow (E110), Allura red AC(E129),Red2 (E128), Carmoisine (E122), and Erythrosine (E127) are the Common Seven Synthetic colors utilized.

Natural Food Colors:

Rich in antioxidant activity, natural pigments such as carotenoids, flavonoids, and anthocyanidins give fruits their appealing hue.

Several advantages of these natural pigments for human health have been investigated and acknowledged after decades of research and development, and they have demonstrated promising application prospects in the food, pharmaceutical, cosmetic, and other industries **(Young and Lowe,2018)**

As the natural pigments in fruits are mostly composed of carotenoids, which contribute red,

yellow and orange color (as apricot and tomato); flavonoids which contribute yellow color (as-citrus); and anthocyanidins which contribute red ,purple, and blue color (grape and blueberry).

These pigments offer strong antioxidant properties and other health advantages including the ability to slow down the aging process, repair the nervous system, prevent atherosclerosis, fight cancer and reduce inflammation.

Research on the natural pigments found in fruits, as well as their antioxidant properties and underlying mechanisms, can assist increase the nutritional value and general quality of fruits through focused breeding.

As stated by **Khoo et al. (2017); Bigwood et al. 2008 and Baby and Antony (2017)** some of the drawbacks of the majority of natural colorants are their reactivity to other food ingredients, their instability in water and their sensitivity to light and heat.

Natural food colorants are in demand due to their dependability ,utility, biological potential, and health advantages; in contrast, synthetic dyes can have serious negative effects.

Synthetic dyes are created chemically, while natural colors are derived from nature and can be separated through somewhat complex extraction procedures.

Through food color processing can become very complicated , it is sometimes difficult to classify them as synthetic or natural colors because , even though they may start with natural

Substances, a series of chemical processes invvoling the extraction or modification of the init -ial substances may be necessary .(Arlt and Ulrike,2011)

Approved food coloring and additives:
A list of approved food coloring and additives have approved by US FDA, European Union and Canadian agency, in equal measure**.** **These** agencies material serve as instructions for using their agents. Agents permitted for use on animals are identified in the FDA Federal register, along with prescriptions for those that are safe for human consumption. Manufacturers of certified color additives on the label **(FDA, 2015).**

Color additives subject to certification by the FDA include:
FD&C Blue No. 1
FD&C Blue No. 2
FD&C Green No. 3
Orange B
Citrus Red No. 2
FD&C Red No. 3
FD&C Red No. 40
FD&C Yellow No. 5
FD&C Yellow No. 6

The European Union (EU) permitted some artificial colors to be used in certain foods and are Subject to specific quantitative limits, according to European Union legislation" (EU, 2015).

The European Union (EU) permits several colors of synthetic origin:
Tartrazine (E102)
Quinoline Yellow (E104)
Sunset Yellow; Orange Yellow S (E110)
Azorubine; Carmosine (E122)
Amaranth (E123)
Ponceau 4R; Cochineal Red A (E124)
Erythrosine (E127)
Allura Red AC (E129)
Patent Blue V (E131)
Indigotin, Indigo Carmine (E132)
Brilliant Blue FCF (E133)
Green S (E142)
Brilliant Black; Black PN (E151)
Vegetable Carbon (E153)
Brown HT (E154)

Public health hazards of artificial colors:
The natural color of food is lost during preparation and storage, making artificial coloring a technological need.

In conventional toxicity trials, the majority of food colors studied exhibited harmful effects at very high ingestion levels.

According to **Kroger et al. (2006),** the majority of food born illness that have documented are caused by the ingestion of textile dyes that

are prohibited, which can cause cancer and damage to nerve tissue **(Kobvlewski and Jacoson, 2012)**

Certain artificial color additives have the potential to trigger allergies ,which can lead to Hyperactivity potentially mutagenic or carcinogenic diseases in youngsters **(Lidon and Silvestre, 2007 -Chung, 2016)**

Hyperactivity in Sensitive Children:
When artificial food dyes and preservatives removed from their diets, 73% of children with a ttention deficit hyperactivity disorder (ADHD), reported fewer symptoms.

In another study, it was discovered that food colors and sodium benzoate made 3-yeares olds and a group of 8 and 9-years olds more hyperactive.

Chronic toxicity: Tartrazine (FD and C yellow No.5) is still one of the coloring agents used most frequently in pharmaceutical, cosmetics and food sector. It has been shown to have a number of harmful consequences in both rodents and humans, including some disruption of reproductive system function.

The reproductive system may be severely harmed by sub chronic tartrazine exposure. However, increasing public knowledge of health risks associated with this dye is imperative **(Boussada & Colleague, 2017).**

Natural food colorants are often a good substitute for synthetic colors when trying to avoid the negative health impact.

What regulations apply to these food additives?
The Food and Drug Administration (FDA) is in charge of overseeing food additive regulations, including safe usage monitoring. Manufacturers and distributors cannot sell food additives until the FDA has evaluated their safety, as required by the Federal Food, Drug and Cosmetic Act (FD &C Act)

The FDA bases in its decisions on the "reasonable assurance of no damage "criterion, where "harm" is defined as adverse effects on human's health.

To guarantee that ingredients added to food are safe for ingestion by humans or animals, the food business must collaborate closely with the FDA and other international regulatory bodies, it also needs to maintain compliance with national and internationals laws.

The government and industry place a high priority on food additive safety and food safety for the benefit of customers.

CONCLUSION

The number of processed foods has increased due to the increasing variety of food production which is linked to range of technological advancement and changes in consumers' dietary habits.

The coloring additives used in food products also have a significant impact on consumer preferences. Their inclinations for naturally derived colorants which are strongly linked to perception of safe, high quality and healthful items have nevertheless, dramatically increased in light of the fact that many synthetic dyes have related health risk.

Food colorant must be used responsibly, within the bound of the law, to achieve specific goals, and taking into account both the immediate and long-term effect. Although consumers have a great perception of the undesirable and harmful effect triggered by synthetic colorants, the strong advantages of natural pigments make them a target of food studies with some additives being replaced by others with greater safety guarantees investigating different natural sources of food great colorants and their possible applications are crucial.

Group of natural colorants need to come up with an option that is healthier than commonly used conventional colorant.

Recommendations

Consumers especially youngsters, should be aware of the potentially harmful effects of consuming such food additives. Artificial colorants are negatively influencing hepatic and renal function when compared to natural color-

ants.

It is strongly advised that appropriate labeling be implemented for food safety, and that consumers be made aware of artificial food dyes through awareness initiatives.

When using food coloring one must adhere to any applicable regulations or restrictions.

More investigation is required to determine the toxicity of artificial food coloring.

The state food health authorities need to be more aware of how to improve the quality of colorful Ready To Eat (RTE) foods manufactured in the non-industrial sector.

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