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Synthetic Food Dyes in Food and Beverage Product Advertisements Seen on Television in the United States

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Key Findings

- **The percentage of food and beverage advertisements seen on all television programming for products containing synthetic food dyes was higher for children ages 2-5 (23.4%), 6-11 (24.1%), and 12-17 (19.8%) years old compared to adults age ≥18 (11.0%).**
- **The percentage of food and beverage advertisements seen for products containing synthetic food dyes was still higher for advertisements seen on children's programming for both 2-5 (36.3%) and 6-11 (53.5%) year olds.**
- **Across age groups and programming audiences, Blue 1, Red 40, and Yellow 5 were the most common synthetic food dyes in food and beverage product advertisements seen on television.**

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Introduction

The use of color additives or dyes in food and beverage (FB) products is multifaceted and includes making products more appealing and showing product characteristics such as flavor visually.[1] For children, the literature provides some support for associations between consumption of synthetic food dyes (SFDs) and hyperactivity, inattention, hypersensitivity and allergic reactions.[2-5] Health concerns have spurred some countries to ban and/or enforce strict labeling of FB products that contain specific SFDs.

In the United States (U.S.), the Food and Drug Administration (FDA) regulates the safety, appropriateness and usage of dyes.[1] There are nine SFDs approved for general use in foods, but only seven are commonly consumed:[6]

Food, Drug and Cosmetic (FD&C) Blue No. 1 - Brilliant Blue (Blue 1)
FD&C Blue No. 2 - Indigotine (Blue 2)
FD&C Green No. 3 - Fast Green (Green 3)
FD&C Red No. 3 - Erythrosine (Red 3)
FD&C Red No. 40 - Allura Red (Red 40)
FD&C Yellow No. 5 - Tartrazine (Yellow 5)
FD&C Yellow No. 6 - Sunset Yellow (Yellow 6)

Effective January 2027, Red 3 will be banned from use in food and beverage products in the U.S.[7]

Research shows that children consume more SFDs than adults.[3,8] There is also a socioeconomic and racial disparity in consumption of SFDs. A study of women and children in the U.S. found that belonging to a household with an income ≤130% of the federal poverty guidelines, having a high school education or less, or being African American were associated with greater consumption of SFDs. Estimated Red 3 intake exceeded acceptable daily intake (ADI) limits for some children.[8] Researchers have recommended that ADI limits be reassessed and there should be reductions in potentially susceptible children's consumption of SFDs.[3] Some states have sought to reduce the public's consumption of SFDs by introducing legislation prohibiting the sale of FB products containing specific SFDs.[9]

There are multiple pathways to reduce children's consumption of SFDs, including reducing exposure to marketing for FBs containing SFDs on television. FB product television advertisements are associated with children's purchase requests.[10] There are currently no U.S. federal government recommendations related to SFDs in FB products advertised on children's television programming. The U.S. Children's Food and Beverage Advertising Initiative (CFBAI) is a voluntary, self-regulatory initiative consisting of 21 FB and quick-service restaurant companies that have pledged to either not participate in child-directed advertising or only advertise FBs to children that meet the industry-developed uniform nutrition criteria. The current iteration of the uniform nutrition criteria does not address the presence of SFDs in products advertised to children.[11] The objective of this paper is to describe the landscape of SFDs in FB product advertisements seen on television in the U.S.

Methods

This is a cross-sectional study of 2022 television ratings data licensed from The Nielsen Company that provide estimated percentages of individuals by age group in households with televisions that saw a program or advertisement. Ratings data were obtained for 2-5- and 6–11-year-olds, as well as for 12-17- and ≥18-year-olds for comparison, and covered exposure from broadcast and cable network, syndicated, and spot television advertising (excluding Spanish-language) from all programming (any program regardless of audience composition) and children's programming (≥35% child-audience [ages 2-11] share) in the U.S. The data provided by The Nielsen Company were aggregated across their national sample, weighted to ensure representativeness, and included the number of advertisements seen for each product on each program and channel. A more detailed description can be found elsewhere.[12]

FB products were categorized into five categories based on classifications from the Nielsen data and study authors' verification: beverages, cereal (e.g. breakfast type, oatmeal), snacks (e.g. chips, crackers, pretzels), sweets (e.g. candy, cookies, frozen desserts), and other foods (canned beans, frozen entrees, soups). Ingredient lists were obtained from either the USDA's Food Data Central, the manufacturer's website, or the ingredient list on the product's food label. We were unable to obtain ingredient information for ≤2% of the FB product advertisements seen across age groups and programming audiences. Ingredient information could not be obtained if the product was a nonspecific food product or the sources above did not have the ingredient information. Each FB product ingredient list was reviewed for the presence of the seven most commonly consumed SFDs (Blue 1, Blue 2, Green 3, Red 3, Red 40, Yellow 5, and Yellow 6).[6] Descriptive statistics were computed in Stata/MP 18.0.

Results

Table 1 shows exposure to FB products containing at least one SFD by age group, programming audience, and product category. The proportion of advertisements seen with SFDs generally decreased with age; from nearly a quarter of advertisements for 2-5-year-olds (23.4%) and 6-11-year-olds (24.1%) to 19.8% for 12-17-year-olds and just 11.0% for ≥18-year-olds. Exposure to FB products with at least one SFD was higher on children's programming compared to all programming for both 2-5- and 6-11-year-olds. Product categories with the highest percentage of products seen containing SFDs were cereals (42.1%, 43.4%, 38.4%, 21.0% for ages 2-5-years, 6-11-years, 12-17-years, and ≥18-years, respectively, of ads seen on all programming and 50-51% of ads seen on children's programming) and sweets (32.1%, 31.1%, 26.3%, 18.5% for ages 2-5-years, 6-11-years, 12-17-years, and ≥18-years, respectively, on all programming and 82-86% on children's programming). Whereas the results for all programming show children 2-5-years and 6-11-years generally saw a higher percentage of products containing SFDs compared to 12-17- and ≥18-year-olds, the percentage of snack and beverage advertisements seen on all programming containing SFDs was higher for adolescents (12-17-year-olds) compared to children and adults.

TABLE 1 **Percentage of Food and Beverage Product Television Advertisements Seen with at Least One Synthetic Food Dye by Age Group, Programming Audience, Product Category and Child Food and Beverage Advertising Initiative (CFBAI) Membership, 2022**

	Ages 2–5		Ages 6–11		Ages 12–17	Ages ≥18
	Programming (%)		Programming (%)		Programming (%)	Programming (%)
	ALL	CHILD[a]	ALL	CHILD[a]	ALL	ALL
All foods and beverages	23.4	36.3	24.1	53.5	19.8	11.0
Beverages	8.8	0.0	8.9	0.0	10.0	7.9
Cereal	42.1	49.7	43.4	51.3	38.4	21.0
Snacks	12.8	1.0	13.2	2.7	14.0	11.3
Sweets	32.1	82.2	31.1	85.8	26.3	18.5
Other	17.8	24.3	19.3	49.4	13.8	3.4
CFBAI	26.6	62.7	27.1	64.1	NA	NA
Non-CFBAI	16.3	15.3	16.8	32.7	NA	NA

a ≥35% child audience share.

The proportion of advertisements seen by 2-5- and 6-11-year-olds for FB products with SFDs was substantially higher for CFBAI vs. non-CFBAI member companies on both all and children's programming. Almost two-thirds (63-64%) of ads seen for CFBAI-member FB products on children's programming were for products that contained at least one SFD.

Across the seven most commonly consumed SFDs, **Table 2** shows that all age groups were exposed most often to FB product advertisements containing Blue 1, Red 40 and Yellow 5. Not only was the proportion of FBs containing SFDs higher for children (and adolescents) than adults (Table 1), but this was also consistently found across all SFDs (Table 2).

TABLE 2 **Percentage of Food and Beverage Product Television Advertisements Seen with Specific Synthetic Food Dyes by Age Group and Programming Audience, 2022**

	Ages 2–5		Ages 6–11		Ages 12–17	Ages ≥18
	Programming (%)		Programming (%)		Programming (%)	Programming (%)
	ALL	CHILD[a]	ALL	CHILD[a]	ALL	ALL
Blue 1	19.1	33.8	19.6	49.4	14.9	7.0
Blue 2	1.8	2.3	1.9	3.6	1.6	1.0
Green 3	0.0	0.0	0.0	0.0	0.0	0.0
Red 3	1.5	2.7	1.4	3.4	1.0	0.4
Red 40	18.1	30.9	18.7	45.2	14.6	7.6
Yellow 5	13.2	18.0	13.9	27.1	11.9	7.3
Yellow 6	6.6	7.7	7.1	12.6	6.3	4.5

a ≥35% child audience share.

Discussion

The results from this study show that an overall higher proportion of FB product television advertisements containing SFDs were seen by children and adolescents compared to adults. Nearly 25% of FB product advertisements seen by 2-5- and 6-11-year-old children were for products that contained at least one SFD, compared to 20% for adolescents and 11% for adults. This could be one reason why there are reports of higher consumption of SFDs among children compared to adults.[3,8] The percentage of advertisements with SFDs was found to be particularly high for sweets and cereal products, which is consistent with research that found roughly 96% of candies and 94% of fruit-flavored snacks contained at least one SFD at a grocery store in North Carolina.[13]

These results are part of a broader landscape of children's exposure to SFDs, which includes not only television and grocery stores but also schools. For example, Smart Snack nutrition guidelines for competitive FB sales in schools do not include guidelines on SFDs. A recent report found that 12% of beverages and 12% of snacks for sale at school contain at least one SFD.[14] Our results showed that over 50% of FB product advertisements seen by 6-11-year-olds on children's programming contained at least one SFD, which may lead to requests for these products at school, making it difficult for schools that want to remove SFDs from campus.

There is a wide range of SFDs across FB manufacturers. Our research found that higher percentages of FB product advertisements seen by children from CFBAI companies contained at least one SFD compared to non-CFBAI companies. One study assessed individual companies and the presence of SFDs in FB products examining multiple categories of FB, and in some cases a CFBAI member's FB products contained the highest percentage of products with SFDs, but that was not the case for every FB category.[15] For example, the study showed that 51% of CFBAI member PepsiCo's energy drinks contained SFDs compared to 33% of CFBAI member Keurig Dr. Pepper's energy drinks. On the other hand, 54% of non-CFBAI member McKee Foods Corp's baked goods contained SFDs compared to 3% of CFBAI member Nestlé's baked goods.[15] There is opportunity for both CFBAI and non-CFBAI members to consider reducing usage or removing SFDs in FB products. CFBAI companies have made a pledge to improve the FB advertising landscape for children and could address SFDs in the next iteration of uniform nutrition criteria for FB products eligible to be advertised to children.

Currently, federal regulations around SFDs in the U.S. do not address advertising, only usage.[1] Effective January 2027, the FDA will ban the use of Red 3 in foods and beverages.[7] This comes on the heels of state-level bills to ban the sale of products containing Red 3.[9] While eliminating Red 3 was the initial focus, expanding to other SFDs has gained momentum. Researchers have identified Red 40 as being the most common SFD used in packaged foods[15] and Red 40, Yellow 5 and Yellow 6 as SFD with the greatest estimated consumption among children and women in the U.S.[8] This aligns with this study's results that Blue 1, Red 40, and Yellow 5 are the SFDs most commonly present in FB product advertisements seen on television. The federal government has yet to formally ban additional SFDs but is working to "phase-out" SFDs from the food supply.[16]

States continue to lead the way on legislative bans for additional SFDs. As of July 22, 2025 the Environmental Work Group reports 29 states have introduced 69 pieces of legislation around food additives including but not limited to SFD. Fifty of those bills are still active and 17 have passed.[17]

The generalizability of this study is high as The Nielsen Company data are nationally representative of U.S. television-equipped households and cover advertising exposure from both cable and network television. However, because the data had been aggregated to provide nationally representative projections, it was not possible to account for sampling variability or formally test the statistical significance of observed differences across product categories or by age groups. Also, advertisements from streaming services were not captured in the data nor did this study examine exposure from other forms of media such as digital/social media.

Conclusions

This study found an overall greater proportion of FB product advertisements seen by children and adolescents compared to adults were for products with SFDs. A greater proportion of CFBAI-company than non-CFBAI-company FB product advertisements seen were for products with SFDs. Blue 1, Red 40 and Yellow 5 were the most common SFDs found in FB product advertisements seen on television. Future research should assess exposure to FB products containing SFDs on streaming services and digital/social media and whether recent and proposed policies such as state-level bans of SFDs impact marketing exposure.

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