ARTIFICIAL COLOR IN FOOD.

by

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Classification of Color In Food.

Color in food may be natural or artificial. The characteristic natural color is of value in that it appeals to the aesthetic sense of the consumer and is an index of the quality of the food. In purchasing fruit for example what safer guide is there than the rich color of the naturally ripened product.

Artificial color if wisely added may also appeal to the aesthetic sense but becomes objectionable when it is harmful, or is used to conceal inferiority, or to give the food an appearance of greater value.

Review of Literature on Food Coloring.

In a review of the literature on artificial food coloring the first reference found concerning the subject was an article, by a Frenchman, in the British Abstracts, Volume 30, page 667, written in 1776, on The Detection Of Fuchsine In Wine.

Distribution Of References.

The distribution of the references found in literature on the subject may be used as an indication of the growth of the use of artificial color in food. One Hundred and seventeen references read were distributed as follows:

Range of years	Period	Number of references
1775 to 1800	25 years	1
1800 to 1900	100 "	25
1900 to 1906	6 "	22
1906 to 1916	10 "	69

This shows that seventy per cent of the literature on the subject has been written since 1900 and sixty per cent since 1906.

Color Laws.

The extensive use of color including harmful dyes soon made color laws imperative. The United States under the Federal Food and Drugs Act of June 30th, 1906, restricted the use of coal tar dyes to seven harmless colors. In 1915 one other color was added to the list.

In addition to this national restriction the laws of the individual states have restricted the use of coal tar and other colors. The laws are directed principally against the use of color to conceal inferiority.

The Kansas Law regarding artificial color is as follows: "Only harmless colors may be used in food products; provided, than when used their presence shall be stated on the principal label. The use of artificial color in meat products, or animal casings for sausages, or other meat products, is prohibited.

Mineral substances of all kinds are specifically forbidden in confectionery, whether they be poisonous or not.

Only harmless colors or flavors shall be added to confectionery; provided that the use of color to imitate the color of another article is prohibited; provided further, that where imitation flavors are used, their presence shall be stated on the label."

The sale of poisonous coloring matters for foods is prohibited in the state of New York and in New York and North Carolina the addition of injurious colors to foods is prohibited.

Minnesota and North Carolina prohibit coal tar dyes in all foods.

Foods and beverages are considered adulterated in North Dakota and Wyoming if they contain aniline dyes or other coal tar dyes.

Artificial coloring is prohibited in sausages by Colorado and Wisconsin.

Artificial coloring, including coal-tar colors, must not be added to vinegar in the states of Arkansas, California, Connecticut, Iowa, Minnesota, Missouri, New Jersey, New York, Pennsylvania, Tennessee, Wisconsin and Wyoming. Distilled vinegar must not contain artificial color in Ohio and Oklahoma, and must be free from harmful artificial coloring matter in Utah.

In South Dakota oleomargarine must not be colored.

Artificial coloring is prohibited in milk by California, Oklahoma, Pennsylvania, Utah and Wisconsin, and in cream by California, Connecticut, Pennsylvania, Utah and Wisconsin.

Coal-tar dyes are prohibited in cakes, crackers, candy, ice cream, and like products by Virginia. Ice cream is considerated adulterated in Michigan if it contains harmful colors.

Forty-six states prohibit the use of poisonous colors in candy. They are as follows: Alabama, Arkansas, California, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Philippine Islands, Texas, Utah, Vermont, Virginia, Washington, Wisconsin and Wyoming.

The leading European countries, such as Austria, Germany, Italy, Belgium and England have color laws in which they prohibit certain colors.

Classification of Artificial Food Colors.

Colors used in foods can be divided into three classes as follows: pigments and lakes, vegetable and animal extracts, and coal-tar colors.

The pigment Ultramarine is harmless and is used in refining sugar to give a blue tint to the sugar. Pigments formed from compounds of lead, copper and arsenic are poisonous and are prohibited.

The source of cochineal is from the dried bodies of the female insect coccus cactis. It is a harmless dye and is quite extensively used.

Cudbear comes from the lichen Lecanora Tinctoria and is also harmless.

Lakes are insoluble compounds of coal tar dyes or natural colours of vegetable or animal origin with metallic oxides. Aluminum and tin lakes are used in the case of cochineal and vegetable colours. Aluminum, tin, calcium, barium, lead, zinc and antimony for the acid coal tar colors. The basic colors are combined with tannin and tartar emetic, resin and fatty acids or compounds of tin and phosphoric acids.

Certified Colors.

The eight certified coal tar colors are

amaranth 107, Poncean 3 R (56), Erythrosin 517, Orange I (85), Naphthol Yellow S (4), Light Green S. F. Yellowish 435, Indigo Disulphoacid 692, and Tartrazine 94. Formerly the natural colours of vegetable or animal origin were most extensively used but now only a few are used. They have been replaced to a large extent by the eight certified coal tar colors.

The chemical composition of the certified colors is as follows:

Chemical Composition of Permitted Coal Tar Dyes.

Amaranth (107) $$C_{10}H_6 \begin{cases} (4)\ SO_3\ Na \\ (1)\ N = N-(1)\ C_{10}H_4 \begin{cases} (2)\ OH \\ (3)\ SO_3\ Na \\ (6)\ SO_3\ Na \end{cases} \end{cases}$$

Poncean 3 R(56) $$C_6\ H_2 \begin{cases} C_2H_5 \\ (C\ H_3)_2 \\ N = N-C_{10}\ H_4 \begin{cases} O\ H\ B \\ (S\ O_3\ Na)_2 \end{cases} \end{cases}$$

Erythrosin (517) $$C = \begin{array}{l} C_6\ HI_2 \begin{cases} O\ Na \\ \quad O \end{cases} \\ C_6\ HI_2 \begin{cases} :O \\ \end{cases} \\ C_6\ H_4\ CO_2\ Na \end{array}$$

Orange I (85) $C_{10}\ H_4\ (N\ O_2)_2\ \ (OK)\ S\ O_3\ K$

$$\text{Naphthol Yellow S(4)}\ C_{10}\ H_4 \begin{cases} (1)\ O\ Na \\ (2)\ NO_2 \\ (4)\ NO_2 \\ (7)\ SO_3\ Na \end{cases}$$

$$\begin{array}{ll} & (1)\ C_6H_4(4)\ SO_3\ Na \\ \text{Light Green S. F Yellowish (435)}\quad C & (1)\ C_6H_4(4){:}N\begin{cases} C_2H_5 \\ CH_2\ .\ C_6H_4\ .\ SO_2\ .\ O \end{cases} \\ & (1)\ C_6H_4(4)\ .\ N\begin{cases} C_2H_5 \\ CH_2\ .\ C_6H_4\ .\ SO_3\ .\ Na \end{cases} \end{array}$$

Indigo Disulphoacid $C_{16}\ H_8\ N_2\ O_2\ (SO_3H_2)_2$

Rules Governing the Certification of a Coal Tar Dye. Bur. of Chem. Bul. 147.

The rules which governed the adoption of these colors are as follows:

All colors which have not been physiologically tested either upon animals or man shall not be permitted for use in foods.

All coal-tar colors which have been examined physiologically with contradictory results shall not be permitted for use in foods.

All coal tar colors which have been examined physiologically and have been declared to be of doubtful harmlessness shall not be permitted for use in foods.

Only those coal-tar colors whose chemical composition was definitely disclosed or otherwise ascertained, and which were on the United States market in the summer of 1907, and which have been examined physiologically and with no other than a favorable result shall, for the present, be permitted for use in foods.

Physiological Effects of Artificial Food Coloring.

The addition of color to food may be objectionable to some but many believe that harmless color should be allowed in articles of food and drink which do not have characteristic colors of their own. Examples of this class of foods are confectionery, jello, gelatin and pop. Such foods, on the other hand, as fruit preserves, jellies, vegetables and catsups having distinct natural colors so that added color will be unnecessary.

In 1906 it was observed that there were between six and seven hundred coal-tar dyes available for coloring purposes. Eighty of these were on the market for food coloring.

Systematic review of the literature wand experiments showed that there was a wide divergence of opinion as to the harmless or harmful nature of the coal-tar colors as a class.

Careful physiological experiments were made which led to the adoption of the four rules given above for guidance in the certification of coal tar colors.

In some cases harmfulness was due largely to contaminations, such as arsenic, which entered during the manufacture of the dye. Regulations preventing the use of such harmful substance, or in making complete purification of the final product resulted in such cases in the production of a harmless dye. In other cases the dye itself was harmful. For example it was found that methyline blue damages protoplasm in a solution of 0.001 per cent. Methyl violet was stored up in juices of the cell, coloring living protoplasm and care was necessary to prevent damage with solutions of

0.0003 to 0.0001 per cent strength. A solution of methyl violet 1:5000 kills anthrax bacillus in two hours. A stronger solution 1 to 150 kills typhoid bacillus in the same time.

In artificial digestion experiments it was found that a few milligrams of color which in relation to digestive fluids would make up a few tenths or hundredths of a per cent, retarded and almost completely inhibited action of the pepsin on albumin.

As the result of these investigations a harmless color is defined as one which will neither retard digestion nor have special physiological effects when consumed in quantities corresponding to two grams per day per adult.

Since coal-tar dyes act physiologically because they are chemicals then before they are used in foods they should be thoroughly tested in the same way a drug is tested before it is put on the market for human consumption. That is, it should be first thoroughly tested physiologically on animals then gradually on man in all conditions of health.

Properties of a Food Color.

Not all coal tar colors are equally adapted for use in food products. The best are those high in their tinctorial power and those which offer the greatest resistance to the action of the materials with which they are to be combined. Those colors which require a mordant to develop them or bring out their color are not desirable since the mordant may introduce an undesirable pigment.

Amount of Color in Foods.

One thing which seems to be an advantage in the use of a coal-tar color for the coloring of foods is that only very small amounts need be used to color large amounts of the food.

Proportions of Color Used in Some Common Foods.

One part of color to:

Beverates	80,000; 120,000; 128,000; 256,000; 1,024,000.
Butter	16,666.
Confectionery	3,500; 12,800; 20,000; 24,576; 30,000; 32,000; 192,000.
Flour	666; 1000.
Pastry	100,000

Sugar	1,333; 4000.
Syrups	4000; 5000.
Whitening sugar	250,000.

Methods of Isolation of a Coal Tar Color.

Two methods are available for the isolation of a coal-tar color in food for identification. Dyeing on wool, and extraction with immiscible solvents.

Dyeing on Wool. Food Analysis. Woodman.

If the material is a liquid, use about 50 c.c. directly; if a solid, about 25 grams should be mixed with water as thoroughly as possible and made up to a volume of approximately 100 cc. If the solution is not already acid, add a drop of hydrochloric acid (sp. gr. 1.12) or enough to produce a very slight but distinct acid reaction, add a piece of white woolen cloth about 2 in. square, which has been thoroughly washed in boiling water, and boil in the colored solution for at least ten minutes, replacing the water lost by evaporation. Remove the wool and if colored rinse thoroughly in boiling water to remove any color which may be adherent to the fiber. Strip the color from the wool by boiling with dilute ammonia, one part of strong ammonia to fifty parts of water. Remove the wool, add dilute hydrochloric acid to the solution until it is faintly acid, immerse a fresh piece of the woolen cloth and boil again for ten minutes. In general, a distinct color on the second piece of wool indicates the presence of a coal-tar dye.

Extraction with immiscible solvents. Woodman Food Analysis.

Prepare an aqueous solution of the colored material by macerating and straining or filtering if necessary, make it alkaline with sodium hydroxide and shake with amyl alcohol in a separatory funnel, carefully avoiding the formation of an emulsion. Test a little of the amyl alcohol layer for basic colors by shaking it with dilute acetic acid in a test tube. If the lower layer is colored, a basic or weakly acid dye may be present and the main portion of the amyl alcohol should be evaporated to dryness on a water bath, adding a little ethyl alcohol from time to time to hasten the evaporation. Take up the residue in hot water and dye the color on wool from a bath faintly ammoniacal in the case of basic dyes, and acid with a drop of acetic acid with weakly acid dyes.

The alkaline solution from which the basic colors have been removed is made strongly acid with one-half its volume of hydrochloric acid, sp. gr. 1.20, and again shaken with amyl alcohol and two or three cc. of ethyl alcohol. Most of the acid colors will be dissolved by the amyl alcohol, although it may not be deeply colored itself. A few of the highly sulphonated colors will still remain in the aqueous layer. The amyl alcohol is drawn off and shaken with dilute sodium hydroxide to remove the color. The aqueous layer is separated, acidified and the color dyed on wool as in the wool dyeing method. If the amyl alcohol still shows some color, it can usually be removed by adding an equal volume of petroleum ether and again shaking with sodium hydroxide. It should be borne in mind that the amyl alcohol will dissolve vegetable colors, so that the presence of coal-tar dyes should not be assumed unless shown by a double dyeing of the color extracted by the amyl alcohol.

Reason For Laboratory Examination For Artificial Color.

The primary object in collecting material for this paper was to find out if possible something about the kind and amount of color used in foods on the market in Kansas.

The majority of the samples were obtained in Lawrence and under such conditions that the results represent approximately the conditions found on the average Kansas market.

In some cases the dealers were told the object for which the samples were being purchased and would give all possible assistance by furnishing samples of all colored foods in their stock. On the other hand some were suspicious and not anxious to have their stock inspected. In this class however most were foreigners and perhaps it was merely an inherited dread of having their products examined and not fear that anything under standard would be found, that made them appear nervous.

One class of food stuff was collected and tested at a time. In this the tests could be more uniformly made. For example fifty samples of confectionery were examined, then seventeen samples of fruit products, and so on.

A total of one hundred and twenty one samples, including a large variety of staple food products, were tested and the following results obtained.

Results of Laboratory Test for Color in Foods.

Confectionery. Wool Dyeing Method, U. S. Bul., 107.

Poncean 3 R (56)	14	Samples.
Light Green S. F. Yellowish (435)	5	"
Orange I (85)	3	"
Naphthol Yellow S (4)	12	"
Amaranth (107)	2	"
Erythrosine	11	"
Cudbear	1	"
Mixture	2	"

Salad Dressing: Extraction with Immiscible Solvent.

Boric Acid Test. U. S. Bul. 107.

Turmeric	2	Samples

Fruit Syrups. Wool Dyeing Method, U. S. Bul., 107.

Poncean 3 R (56)	4	Samples
Cudbear	1	"
Orange I	1	"
Naphthol Yellow S (4)	2	"
Mixture	1	"
No color	8	"

Jello

Cudbear	3	"
Turmeric	1	" Boric acid test, U. S. Bul., 107.

Pop. Wool Dyeing Method. U. S. Bul., 107.

Amaranth (107)	5 Samples
Ponceau (3R) (56)	2 "
Orange I (85)	2 "
Naphthol Yellow S (4)	1 "
No color	1 "

Food.	Method of Identification	--Reference	--Result	--No.
Butter	Extraction with Immiscible Solvent.	U.S. Bul. 107	Annatto	2
Cheese	" " "	" " "	" "	1
			No color	1
Jelly	Wool Dyeing	" " "	107 Dye (435)	1
			No color	2
			Ponceau 3R	1
Jam	" "	" " "	"No color	2
Pastry	" "	" " "	Erythrosine	1
			No color	1
Pickles	Examination of Ash	" " "	107 " "	1
Coffee			" "	1
Tea			" "	1
Cocoa	Wool Dyeing	U.S. Bul.,107	" "	1
Chocolate	" "	" " "	" " "	1
Pepper	Microscopic	" " "	" " "	2

Rice	Test for Ultramarine--Leach		No color	2
Extracts	Wool Dyeing	U. S. Bul. 107	" "	3
Fruit coloring	Wool Dyeing	" " " "	" "	2
Peas	Examination of Ash	" " " "	" "	1
Olives	" " "	" " " "	" "	1
Vinegar	Lead Subacetate test	Leach	" "	1
			Caramel	1
Catsup	Wool Dyeing	U. S. Bul. 107	No Color	1
Mustard	Boric acid test	" " " "	" "	2.

Of the one hundred and twenty-one samples tested eighty-four were colored, leaving thirty-seven samples with no added artificial color. No mineral pigments were found. Eleven samples contained vegetable color which was found in confectionery, salad dressing, mustard, vinegar and jello. Seventy-three of the colored samples were dyed with coal tar dyes but only certified colors were found. The coal tar dyes were found in confectionery, fruit products and pop.

The results of these tests bear out the statements found in literature that coal tar dyes are most extensively used for food coloring as over one half of the samples contained coal tar dyes.

The color laws seem to be effective in restricting the dyes used to the eight certified colors.

Another favorable condition found was that in the majority of cases color was added to foods which had no characteristic color of their own as in the case of confectionery, pop and jello.

Dyes Which Have Been on the American Market for Foods.

At present about fifteen hundred coal-tar dyes are on the market. Many of these may be suitable for food coloring but considerable time is necessary to test them out physiologically and it is considered best to keep the certified number of colors to as few as possible and yet give the shades which are necessary for use in food coloring.

The following list contains most of the dyes which have been sold on the American market for food purposes. This classification was made by Albert F. Seiker in Allen's Commercial Organic Analysis, Vol. V.

Dyes Which Have Been on American Market For Food Purposes.

4. Naphthol yellow S.
8. Acid yellow
9. Fast yellow
10. Soudan G.
11. Soudan I.
13. Poncean 4 G B.
14. Orange G.
16. Butter yellow.
17. Chrysoidine Y.
18. Chrysoidine R.
49. Soudan II.
53. Palatine scarlet
54. Scarlet G R.
55. Poncean R, 2R, G, G R.
56. Poncean 3 R.
60. Scarlet 2 R.
64. Crystal scarlet 6 R.
65. Fast red B.
84. Resorcin yellow
85. Orange I.
86. Betanaphthol orange
89. Brilliant yellow S.
94. Tartrazine
95. Metanil yellow
97. Orange T.
101. Fast brown N.
106. New Coccine
107. Amoranth
108. Scarlet 6 R.
137. Resorcin brown
139. Fast brown
146. Brilliant crocein M.
169. Crocien scarlet 7 B.
188. Naphthol black B.
197. Bismark brown.
201. Bismark brown M.
240. Congo red
269. Chrysamin R.
287. Azo blue
329. Chrysophenin
398. Naphthol Green B.
425. Auramine

427. Malachite Green
428. Brilliant Green
433 Guinea green B.
434. Light green S F bluish
435. Light green S F yellowish
439. Cyanol extra
440. New patent blue B, 4 B.
448. Magenta
451. Methyl violet B.
452 Crystal violet
462. Acid magenta
464. Acid Violet 4 BN.
468. Acid Violet 4 B extra
476. Methyl Alkali Blue
480. Water blue
502. Rhodamine G.
504. Rhodamine B.
510. Fluorescein
512. Eosin
516. Erythrosin G.
517. Erythrosin
518. Phloxin P.
520. Rose bengal
584. Safranin
601. Soluble indulines
650. Methyline blue B, B G.
655. New Methyline blue N.
557. Quinoline yellow
692. Indigo carmine.

The effect of the Federal law restricting the use of coal tar colors then has been to reduce the number of colors from the seventy-two possible colors given in the above list to eight harmless ones which in general seem to be wisely used.

Artifically Colored Foods On The Market.

When artificial food coloring is mentioned confectionery or fruit products are usually thought of as being most commonly colored but upon a survey of the colored foods on the market it seems that no food product escapes artificial color, especially if the cheaper grades are examined.

The following table shows the large variety of foods which may have artificial color.

Artificially Colored Foods On The Market.

Allspice	Fruit Syrups
Almond Extract	Ginger
Apple "	Grape Juice
Apricot "	Grape Essence
Butter	Gooseberry Essence
Beer	Gelatin
Bread	Jam
Banana Extract	Jelly

Black Cherry Extract
Beet Pickles
Cheese
Confectionery
Cider
Cocoa
Chocolate
Cherries
Coffee
Currant Extract
Capers
Cucumber Pickels
Cayenne Pepper
Chili Sauce
Cloves
Egg shells
Pop
Perry
Pickles
Preserves
Pineapple Extract
Pear "
Plum "
Peach "
Piccalilli

Ice Cream Cones
Ice Cream
Lemon Essence
Macaroni
Meat
Milk
Melon essence
Molasses
Mustard
Nutmeg
Nuts
Orange Extract
Olive Oil
Olives
Oranges
Oleomargarine
Pepper
Quince Extract
Raspberry "
Rice
Sausage
Sirups
Sugar
Strawberry Extract
Spaghetti

Tea

Tapioca

Wine

Whisky

Watermelon

Foods Classified According to Their Added Color.

Examination of food colors to find the chief aim of the food color artist may be made with the aid of the following table in which foods are classified according to the shade of their added color.

Red

- Beet Pickles
- Confectionery
- Cherries
- Cayenne Pepper
- Chili Sauce
- Fruit Syrups
- Gelatin
- Jelly
- Jam
- Meat
- Pop
- Ice cream

Orange

- Confectionery
- Fruit Syrups
- Ice Cream
- Gelatin

Pink

- Ice Cream
- Ice Cream Cones
- Confectionery

Blue

- Confectionery
- Sugar
- Tea
- Tapioca

Green

- Cherries
- Mint Jelly

Yellow

- Butter
- Cheese
- Confectionery
- Noodles
- Egg Shells
- Ginger
- Fruit Syrups
- Gelatin
- Macaroni
- Spaghetti
- Milk
- Mustard
- Olive Oil
- Oleomargarine

Violet

- Confectionery

Brown

- Beer
- Bread
- Confectionery
- Cider
- Cocoa
- Chocolate
- Coffee
- Cloves
- Molasses
- Nuts
- Pop
- Pepper
- Sirups

Judging from this classification, artificial color of such a shade is added, where a food has a characteristic natural color, to improve this color or make up for the lack of it and where there is no characteristic color, as in the case of green mint jelly and green cherries, merely to the aesthetic sense.

Colors Classified According To Their Adaptibility for a Definite Food.

One dye may be more valuable for use in one food than in some other. For example, Ultramarine is especially good to give the blue tint to sugar.

Dyes then may be classified according to their adaptibility to definite foods. Knowing this adaptibility of colors the analyst can work with more certainty in identifying colors.

Classification of Colors As Found In Foods.

(Leach and other references given in Bibliography)

Confectionery

Eosin	Acid Fuchsin	Acid Violet 6 B.
Erythrosin	Naphthol Yellow S.	Prussian Blue
Rose Bengale	Chrysoin	Copper Carbonate
Bordeaux B.	Aurimine O.	Mercury sulphide
Crystal Poncean	Orange I.	Gamboge
Bordeaux S	Malachite Green	Read Lead
New Coccine	Acid Green J.	Lead Chromate
Fast Red	Water Blue 6 B.	Arsenic
Poncean R. R.	Patent Blue	Amber
Scarlet R.	Paris Violet	Copper Arsenite
White Lead	Turmeric	Copper sulphate

Oxide of Iron	Aunatto	Vermillion
Sugar		
Ultramarine		
Tin salts		
Sausage and Meats		
Red Ochre	Safranin	
Cochineal	Eosines	
Cochineal Lake	Ponceans	
Carmine	Bordeaux red	
Fuchsine	Benzopurpurin	
Diamond Red	Mixtures	
Pastry		
Saffron	Victoria Yellow	Orange I.
Aunatto	Martius Yellow	Orange II.
Naphthol Yellow S.	Metanil Yellow	Quenoline Yellow
Tropaeolinis	Puric acid	Tartrazine
Turmeric	Aurantia	Azo Yellow
Gold Yellow		
Canned Vegetables		
Copper		
Mustard		
Turmeric		
Nitro colors		
Naphthol Yellow S.		
Naphthol Yellow		

Cayenne Pepper

- Mercury sulphide
- Read lead
- Oxide of Iron
- Turmeric

Tea

- Prussian Blue
- Carbon
- Ultramarine
- Indigo

Coffee

Caramel	Soot	Lead Chromate
Coal Tar Dyes	Ultramarine	Calcium Carbonate
Graphite	Malachite Green Lake	Talc
Tannate of Iron	Prussian Blue	

Cocoa and Spices

- Pigments and Lakes
- Brick Dust
- Charcoal
- Red sandal wood and other brown and red woods
- Turmeric
- Coal Tar Dyes

Vinegar

- Caramel
- Coal Tar Dyes

Cayenne Pepper

Mercury Sulphide

Red lead

Oxide of Iron

Extracts

Prune Juice

Coal Tary Dyes

Wines

Basic Dyes	Erythrosine	Orange R. R.
Cochineal	Bordeau red B.	Tropaeoline M.
Alkanet	Soluble red	Tropaeoline II.
Archil	Purple red	Yellow I.
Bilberry	Croceine 3 B.	Fast Yellow
Chicary	Poncean R.	Binotro
Fuchsin	Poncean B.	Naphthol Yellow
Magenta	Orange R.	Yellow N. S.
Persio	Orange R. R. R.	Safranne
Acid Fuchsin	Orange II.	Chrysoidine
Chrysoiline	Red N. N.	Methylene Blue
Chrysone	Red I.	Coupier's Blue
Methyl-eosine	Poncean R. R.	Dipheuylamine
Yellow II.	Eosine J.	Rosanilines

Milk Products

Aunatto Methyl Orange

Caramel	Orange IV
Auilin Orange	Soudan I.
Turmeric	Cerasin Yellow
Saffron	Yellow O. B.
Carotin	Yellow A. B.
Aniline Yellow	Curcumin
Butter Yellow	Carrot
Victoria Yellow	Aldeney Butter Color
Martins Yellow	Ranson's " "
Acid Yellow	Dandelion " "
Cimethyl-amido-azo benzene	
Tropaeolins	Sulphonated-azo-compounds

Fruit Products

Cochineal	Magenta
Puric Acid	Acid Fuchsine
Dimtrocresol	Tropaecline
Martius Yellow	Ponceans
Orange II.	Bordeaux red
Metanil Yellow	Eosines
Fuchsine	Rose Nouveau
Sulphonated nitro colors	Carmine
Methyl Orange	Cu SO_4
Saffoline	

Harmless and Harmful Colors.

Mineral colors are harmful because the metallic part of the compound fomms insoluble compounds in the body which lodge in the body cells and prevent them from functioning.

Harmful Mineral Colors. Leach.

Copper sulphate	Massicot
Blue ashes	Red lead
Mountain blue	White lead
Cassel yellow	Paris yellow
Turner yellow	Naples yellow
Sulphate of lead	Chromo yellow
Cologne yellow	Ultramarine yellow
Vermillion	Scheeled green
Schiveinfurth green.	

Harmless Mineral colors. Leach.

Ultramarine blue

Ultramarine violet

Manganese brown

Ultramarine green.

Organic colors also may act chemically on the body producing harmful results.

Harmful Organic Colors. Leach.

Poncean 3 R B	New Red L .
Poncean B extra	Scarlet E C.

Fast Poncean B.	Imperial Scarlet
Old Scarlet	Biebrich scarlet
Crocein Scarlet 3B.	Poncean 4 R B.
Cochenille Red A.	Crocein scarlet 4 B.
Brilliant Scarlet	Brilliant Poncean 4 R.
Poncean 4 R.	Poncean Brilliant 4 R.
New Coccin Scarlet	Crocein Scarlet 7 B.
Crocein Scarlet 8 B	Poncean 6 R. B.
Green,	Dinitrosoresorcin
New Green,	Solid green O in paste
Solid green crystals	Dark green
Solid Green O	Chlorine green
Diamond green	Russia green
Bitter almond oil green	Alsace green
Fast green	Fast green
	Resorcinol green

Mixtures of harmless blue and yellow colors.

Blue colors

Indigo	Gentian Blue 6 B.
litmus	Spirit blue
Archil blue	Spirit blue F C S.
Opal blue	Blue lumiere
Hessian blue	Light blue
Coupier's blue	Indigin D F.
Fast blue R and B.	Indulin
Solid blue R R and B	Indophenin extra

Blue C B

Noir C N N.

Myrosin

Violet Colors.

Paris Violet	Mauvein
Methyl violet B and 2 B	Rosolan
Methyl violet V_3	Violet paste
Pyoktanin	Chromo violet
Coeruleum	Anilin violet
Malberry blue	Anilin purple
Wool black	Perkins violet
Naphthol black P	Indisin
Azoblue	Phenamine
	Purpurin
	Tyralin
	Tyrian purple
	Lydin

Brown Colors

Caramel	Safranin I
Licbrice	Safranin extra G
Chrysamin R	Safranin G extra G G S S
Crocun scarlet O extra	Safranin G O O O
Safranin	Safranin F F extra No. O

Safranin conc

Safranin A G extra

Safranin A G T extra

Anilin pink

Yellow Colors.

Gum gutta

Puric acid

Martius yellow

Naphthylamine yellow

jaune d'or

Manchester yellow

Naphthalin yellow

Naphthol yellow

Jaune naphthol

Victoria yellow

Victoria orange

Anilin orange

Decritrocresol

Saffron substitute

Golden yellow

Tropaeolin G

Victoria yellow

Jaune G (metanil extra)

Sudan I Carminnaphte

Orange II

Orange No. 2

Orange P.

Orange extra

Orange A.

Orange G

Acid orange

Gold orange

Mandarin G extra

Betanaphtholorange

Tropaeolin 000 No. 2

Mandarin

Crysaurin

Metanil yellow

Orange MN

Orange IV

Orange No. 4

Orange N

Orange G S

New Yellow,	Diphenylorange
Acid yellow D	Diplunylamine orange
Tropaeolin O O	Jaune d'anilin
Fast yellow	Anilin yellow

Green Colors.

Naphthol green B

Blue Colors.

Methylene blue B B G	Methylene blue B B
Methylene blue D B B extra	Methylene blue B B

Brown Colors.

Bismark brown	Bismark brown G
Manchester brown	Phenylen brown
Vesuvin	Anilin brown
Leather brown	Cinnamon brown
Canelle	English brown
Gold brown	Vesuvin B.
Manchester brown E E	Manchester brown P S
Bismark brown	Bismark brown T
Brun Bismark E E	Fast brown G
Brown chrysoidin	Chrysoidin G.
Chrysoidin R.	Chrysoidin J.
Chrysoidin Y.	

Harmless Organic Colors.

Red Colors.

Cochineal Carmine	Carthamie

Redwood

Cherry and beet juices

Eosin

Eosin G extra

Eosin water soluble

Eosin 4 J extra

Eosin K. S

Eosin J J. F

Erythrosin D

Pyrosin B

Eosin bluish

Dianthin B.

Rose bengale N

Rose bengale G

Phloxin

Eosin blue

Eosin 10B

Artificial alizarin and purpurin

Eosin A.

Eosin G G F

Eosin 3 J

Eosin extra

Eosin D H.

Erythrosin

Erythrosin B

Primrose solution

Eosin J.

Rose Bengale

Rose bengale A T

Bengalrosa

Phloxin T A

Cyanosin

Bordeaux and Poncean reds, resulting from the action of naphthol sulphonic acids on diazoxylene.

Poncean 2 R

Poncean G R

Poncean G

Poncean R

Brilliant poncean G.

Poncean J

Bordeaux B

Fast red B

Bordeaux R extra

Cerasin

Rougt B

Poncean 2 G

Brilliant Poncean G G

Poncean J J

Fuchsin S. and magenta

Rubin S

Fuchsin acid

Archit substitute

Naplithron red

Orange I

Orange No. I

Naphtholorange

Alpha-nalphtholorange

Tropaeolin OOO No. I

Congo red.

Azorubin S.

Azorubin

Azorubin A

Azoacidrubin

Fast red C

Carmoisin

Brilliant carmoisin O

Rouge rubin A.

Fast Red

Fast red E

Fast red S

Acid carmoisin S.

Poncean 4 G B

Crocein orange

Brilliant Orange G

Orange G R X

Pyrotin orange

Orange E N L

Fuchsin

Metanitrazotin

Yellow and Orange Colors.

Annatto

Saffron

Safflower	Turmeric
Naphthol Yellow S	Citronin A
Sulphur Yellow S.	Jaune acid
Jaune acid C.	Anilin yellow
Succinine	Saffron Yellow
Solid Yellow	Yellow S.
Brilliant Yellow	Poncean 4 G B
Crocein orange	Brilliant Orange G
Orange G R X	Pyrotin orange
Orange E N L	Fast Yellow
Fast Yellow G	Fast Yellow
Fast Yellow S.	Acid Yellow
New Yellow	Fast Yellow R
Fast Yellow	Yellow W.
Azarin S.	Orange I.
Orange No. I.	Naphtholorange
Alpha-naphtholorange,	Tropaeolin 000 No. I.
Orange	Orange G T
Orange R N	Brilliant Orange O
Orange N	

Mixtures of harmless red and yellow colors.

Green Colors.

Spinach green

Chinese green

Malachite green

Malachite green B

Benzaldihyde green

New victoria

Conclusion:

The characteristic natural colors should be preserved in all foods so that the product will satisfy the consumer as to quality and at the same time appeal to the aesthetic sense. If this is done it will be possible to confine artificial coloring almost entirely to foods without characteristic color as confectionery, pop and jello.

In some cases, however, where the color plays such an important part in determining the value of the product as in the case of butter, it seems that a uniformly colored product can be obtained only by the addition of artificial color. When the consumer is aware that the butter is colored merely for its aesthetic value and not to conceal inferiority then it would seem to be no more objectionable to use color in butter than in confectionery.

The problem of artificial color has been of vital interest for only about ten years, that is, since the number and uses of coal tar colors has increased so enormously. About ten years ago the fact that some coal tar dyes were harmful was fully realized and steps taken to restrict their use. Since this restriction and the fact that such small amounts of these certified colors are added to foods there is no doubt that they are harmless and even though artificial color is used in such a large veriety of foods, the actual harm physiologically to a given individual is practically nil.

Therefore, after reviewing the literature and making tests on foods in the laboratory, it seems apparent that the Federal and State color laws have been successful in increasing the quality of artificially colored foods on the market since they have prohibited poisenous colors and have reduced the number of coal-tar colors used from about eighty to eight harmless ones which has aided in diminishing the amount of coloring to conceal inferiority.

From these results it may be seen that when there is no intention to deceive the consumer and the color is added simply to satisfy the aesthetic sense there can be no serious objection to its use.

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