NATURAL ALTERNATIVES TO COMMON FOOD COLORS

PRESCOUTER

2022

Growing demand for natural food coloring can offer lucrative opportunities with added clean-label and health benefits.

Recent bans on colored food additives that are deemed “unsafe” (e.g., titanium dioxide (TIO_2), also known as E171, and color dyes Yellow No. 5 and No. 6, Red No. 40) are accelerating the development of natural dyes capable of matching brighter hues and the required stability.

The European Food Safety Authority no longer considers TIO_2 to be safe as a food additive. The European Commission will phase out the use of TIO_2 within six months, by which time food producers will need to find healthier food coloring alternatives to sustain their products on the market.

France banned the use of TIO_2 in 2020. A French company, Lonza, launched Vcaps Plus White Opal, a TIO_2-free semi-opaque capsule used for food supplements, while the French Agency for Food, Environmental and Occupational Health & Safety has started a systematic plan to assess engineered nanomaterials with the potential to be used as food additives and ingredients with a nutritional function.

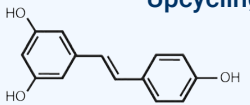
These types of regulations are limiting the use of artificial dyes and are helping to propel the demand for natural food coloring additives, with a potential market that could reach US$3.2 billion by 2027.

In this Intelligence Brief, we explore the current direction of natural food coloring additives in the food and beverage industry and exemplify some innovative commercially available approaches that offer opportunities for making appealing colored food products without sacrificing quality.

Although most of the cost to produce a natural color (40%-70%) is linked to its raw material, which contains less than 2% of color or pigment, there are several approaches that will help improve production costs in the short and long term.

ALTERNATIVES TO ADDRESS THE PRODUCTION OF NATURAL FOOD COLORANTS AT LARGE SCALE

Upcycling botanical surplus



grape seed extract

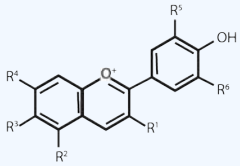
Sensient's upcycled grape skin based colors

Designing proprietary color crops with superior pigment yields (i.e., more pigments and color yield from raw materials)

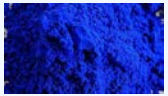
Lycored's proprietary tomato crops with enhanced color yield

Development of new technologies that help maximizing the extraction of pigments, processing, and stability.

Lycored
Microencapsulation process



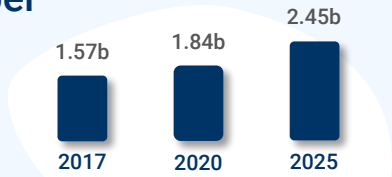
anthocyanin molecule



Peak B Enzymatic extraction

As color Biotech; AstaReal produces and aim to improve strains and pigments stabilization to increase the yield of natural food colors from microalgae, fungi, yeasts and bacteria without co-production of toxins

As consumers globally move toward higher demand for clean-label products, ingredients such as natural food colorings could contribute to US$3.2 billion in market growth by 2027.

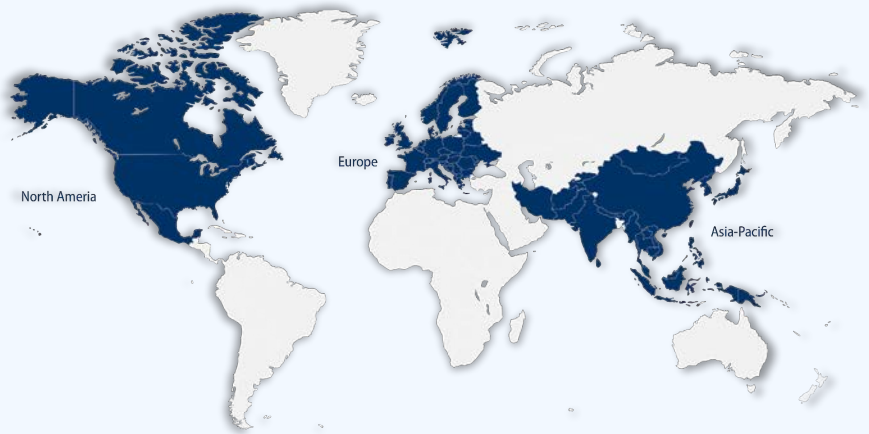


Global value of the natural food coloring market 2017 to 2025. Source: Statista.

A global demand for clean-label products is propelling the natural food colorant market to grow.

Food & Beverage companies are increasing efforts in R&D. New findings indicate that lucrative opportunities are here to stay.

Europe emerges as the largest market for food colorants (34%), followed by the Asian-Pacific region (31%).



https://www.mordorintelligence.com/industry-reports/food-colorants-market
https://www.marketsandmarkets.com/Market-Reports/food-colors-market-36725323.html

Innovation in natural food coloring has increased almost five-fold in filed patents between 2010 and 2020.

The search for natural products had an important effect on Food and Beverage companies.

- Since 2012, companies such as McCormick & Company, Mars Inc, Motif FoodWorks, Fermentalg, Colorcol, among others, filed color additive petitions to expand the safe use of natural food colors to hold to the clean-label trend.
- Revisions and risk assessments related to artificial food colors are in progress globally. National regulatory agencies such as the USFDA, have established firmer rules for artificial food dyes containing Lead, Arsenic, and Mercury.
- The ban of food additive TIO_2, in Europe echoed in the US, with Blue California launching a clean-label food grade whitening agent.
- The Natural Food Color Association (NATCOL) has elaborated a Code of Practice for Coloring Foods in Europe. The code helps industries to meet acceptable standards related of classification, manufacturing, use and labelling of coloring foods.

Figure. Natural food coloring patent application trends show increased innovation over the past decade.

The strategies and information provided in this report are an example of the insights clients rely on PreScouter for.

PreScouter is helping companies implement more sustainable practices throughout the entire product lifecycle, while ensuring the safety of products for consumer health, through the services listed on the right.

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Challenges Conquered

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"Working with PreScouter is like having a secret information drawer. When you need perspective and insight you can open the drawer and, presto, you have what you need."

Rowena Pullan, Strategic Innovation Leader, VP Wellness R&D at Pfizer

PreScouter's research consultancy has helped drive strategic planning and specific solution development decisions for some of the most sustainable and prominent companies in the world, for years.

1. Identifying novel biobased and/or natural sources with similar or better efficacy compared to currently sourced ingredients.
2. Assessing actionable technologies that enable consumers to tailor the use of active ingredients to their specific needs.
3. Reviewing and ranking competitor activity to determine areas of opportunity and differentiation.

SUMMARY OF THE COMPANIES PROFILED

	# of Employees	Country	Product Name	Composition / Source	Color	End Product Application
Peak B Natural Blue Colorants	10-20	USA	Natural Cyan blue	Red cabbage cyan blue anthocyanin	Natural cyan blue that matches the blue synthetic colorant Brilliant Blue	Food and confectionary products
Lycored	100	Israel	Natural Carotenoid-based colorants	Tomato and marigolds (*blakeslea trispora*)	Yellow, orange, pink, and red	Food and Beverage products (processed foods, baked products, dairy products and beverages).
SENSIENT FOOD COLORS	200	USA	Avalanche	Simple starch and mineral-based solutions	Opacity agent	Panned applications, baking, confection, dry grocery, pet food, dry grocery, sauces, condiments and dairy.
EXBERRY®	200	Netherlands	Exberry Food Coloring	Blends of fruits, vegetables, or edible plants	Full rainbow of colors with the exception of white	All food and beverages categories, including confectionery, dairy, bakery and savory applications.

4 NEW FOOD COLOR ALTERNATIVES

NATURAL CYAN BLUE

Derived from **Red cabbage cyan blue anthocyanin**

Food and confectionery products

Peak B
Natural Blue Colorants

NATURAL CAROTENOID-BASED FOOD COLORANTS

Derived from **tomato** and **marigolds**

Processed foods, baked products, dairy products and beverages

Lycored

AVALANCHE

Derived from **simple starch** and **mineral-based solutions**

Panned applications, baking, confection, dry grocery, pet food, dry grocery, sauces, condiments and dairy.

SENSIENT FOOD COLORS

EXBERRY-FOOD COLORING

Derived from blends of **fruits**, **vegetables**, or **edible plants**

All food and beverages categories, including confectionery, dairy, bakery and savory applications.

EXBERRY®

Peak B: Natural Blue Colorants

Overview:

The natural cyan blue is derived from a red cabbage anthocyanin, a pigment that gives the blue, red, and purple colors to plants. The red cabbage's cyan blue anthocyanin can be expressed with the ideal wavelength with the help of a hydrolytic enzyme. This natural cyan blue now seems to match and likely replace the blue synthetic colorant Brilliant Blue (FD&C Blue No. 1, cyan blue).

AT A GLANCE

Peak B
Natural Blue Colorants

https://www.peakbbio.com/
info@peakbbio.com
Davis, California
10-20

SUMMARY

TYPE OF MATERIAL
Natural

SOURCE
Red cabbage

SCALE OF OPERATIONS
At commercialization stage, and also likely being tested in some Mars products.

END PRODUCT USE
Food and confectionery products

Peak B: Natural Blue Colorants

Technical Data:

Natural Cyan blue can be obtained with the use of a patented highly selected hydrolytic enzyme.

Red cabbage can generate blue colors at pH 7 to 9. The red cabbage anthocyanins produce a vibrant and attractive blue color in pH-neutral solution.

The resultant natural cyan blue is originated from a mono acylated anthocyanin, which has a unique ability to generate a cyan blue hue. Because all enzymes are naturally found also in fruits, the new colors fit the clean-label definition.

Advantages:

A highly stable blue color and likely to produce green colors in larger amounts.

Stability in sugar syrup lasts over 55 days with a 14% loss of color.

In contrast to others such as spirulina, the end product of the red cabbage pigment makes an option that can fill market demand, much less expensive than spirulina.

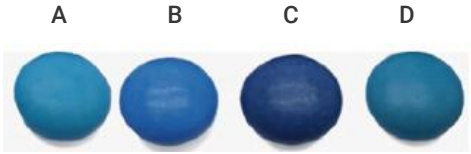

Figure 1. Sugar-coated lentils using: **A:** FD&C Blue No. 1, **B:** spirulina, **C:** RCAs at pH 8, and **D:** $Al^{3+}(P2-)_3$ at pH 7 (Natural Cyan Blue)

Figure 2. Sugar-coated lentils using **A:** synthetic green, **B:** spirulina+Saf, **C:** red cabbage+Saf at pH 8, and **D:** $Al^{3+}(P2-)_3$+Saf at pH 7 (Natural Cyan Blue). Saf = Safflower as yellow color additive.

A & **D** for both figures show same hues

Peak B: Natural Blue Colorants

Applications:

The new natural colors has been tested on:

- Candy coatings, ice cream, and Icing.
- Undergoing research is testing coloring properties and degradability on yogurts, baked goods and doughs.

Developer Overview:

Peak B was founded in 2022 and is headquartered in Davis, California. Peak B aims to offer natural alternatives to synthetic food colorants without sacrificing quality, stability and potency. Peak B has a patented enzyme-based process that extracts blue and green colorants from natural sources.

Figure 3. Natural blue color compared to artificial blue and blue obtained from Spirulina (left), and used as blue colorant in ice cream preparation (right),

References:

1. https://www.peakbbio.com/
2. https://www.science.org/doi/10.1126/sciadv.abe7871#pill-F4
3. https://www.lens.org/lens/patent/195-238-864-327-601/frontpage?l=en
4. https://www.foodnavigator.com/Article/2021/06/02/Scientists-hail-long-awaited-discovery-of-naturally-derived-cyan-blue-colourant
5. https://www.mars.com/mari
6. https://www.ucdavis.edu/news/new-natural-blue-food-coloring

Lycored: Microencapsulated Natural Colorants

Overview:

Lycored use proprietary technologies to develop colorant family from lycopene obtained from tomatoes and beta-carotene from blakeslea trispora. Its yellows, oranges, pinks, and reds are certified kosher and halal, vegetarian friendly, non-GMO, and heat, light, and pH stable.

Lycored relies on two key technologies (own lycopene strain source and microencapsulation). The microencapsulation technique not only protects the stability of ingredients, but contributes to prolong the product shelf life.

AT A GLANCE

Lycored

https://www.lycored.com/
Email form
Israel
98

SUMMARY

TYPE OF MATERIAL
Natural

SOURCE
Tomato and marigold (*blakeslea trispora*)

SCALE OF OPERATIONS
At industrial level, with representation in the US, Switzerland, Ukraine, and Israel.

END PRODUCT USE
Food products or beverages including processed foods, baked products, dairy products and beverages.

Lycored: Microencapsulated Natural Colorants

Technical Data:

Lycopene-based colorants are derived from non-GM and lycopene-rich tomatoes and marigolds grown on Lycored farms in Israel and California.

Unlike carmine food colors (suitable for vegetarians and vegans), Lycored colors can be declared as “lycopene from red tomatoes” on the label, allowing dairy manufacturers to develop milk beverages with a “natural” or “free-from” sell.

Advantages:

Robust alternative to sensitive natural reds such as beetroot and anthocyanins, and stable in product containing Vitamin C.

Stable natural colors overtime, and shade variations and formulations suitable for high fat systems.

Responds well to UHT processing, temperature extremes, and extreme shelf-life outperforming artificial alternatives.

Lycored natural red color shades are kosher and halal-friendly. Provide authentic, vegan pink to red shades.

Figure 1. Lycored natural red colors scores compared to artificial sample on naturalness (based on 506 surveys).

Figure 2. Color stability after six months at ambient temperatures of between 25-40°C

Lycored: Natural Carotenoid-based Colorants

Applications:

Food products or beverages including processed foods, baked products, dairy products and beverages.

Developer Overview:

Lycored, founded in 1995 and headquartered in Israel, has developed a unique microencapsulation technique that keeps ingredients stable which are used in the supplement and nutrition and food and beverage industries (e.g., food coloring, and flavor enhancement applications). Lycored extracts carotenoids from natural sources (tomatoes and marigolds) such as lycopene, alpha-carotene, lutein, astaxanthin, beta-Carotene, and phytoene and phytofluene.

Figure 3. Natural colors developed by Lycored used for different food and beverage applications.

References:

1. https://www.lycored.com/
2. https://www.lycored.com/natural-colorants-for-food/
3. https://www.lycored.com/wp-content/themes/lycored/dist/images/true-colors-paper.pdf
4. https://www.lycored.com/wp-content/themes/lycored/dist/images/resilient-reds-paper.pdf
5. https://www.lycored.com/wp-content/uploads/2019/11/CompilationofLycored-Stability-Studies_ebook.pdf

Sensient Food Colors: Opacity agent

Overview:

Sensient Natural colors is offering a patented alternative to titanium dioxide (titanium dioxide, E171) called Avalanche. A simple starch and mineral-based solution, Avalanche is an opacity agent that can be used in any pH system and on a large variety of applications. Its natural formulation makes Avalanche a clean-label product which is highly stable, claimed to have a great mouth feel and provide fantastic whitening properties.

AT A GLANCE

SENSIENT FOOD COLORS

https://sensientfoodcolors.com
SensientColor.Orders@sensient.com
US
200

SUMMARY

TYPE OF MATERIAL
Natural

SOURCE
Simple starch

SCALE OF OPERATIONS
Sample request. Interested parties must fill in personal information and intended application

END PRODUCT USE
Panned applications, baking, confection, dry grocery, pet food, dry grocery, sauces, condiments and dairy.

Sensient Food Colors: Opacity agent

Technical Data:

Avalanche is a natural white opacifier (clean label) containing simple ingredients such as starch and mineral based solutions. Avalanche currently has a wide portfolio of products designed to best match the requirements met by titanium dioxide.

Label-friendly and preservative free.

The product can be used in any pH system, in low to high water applications.

Advantages:

The product has no flavor off-notes, thus can be used as a substitute in calcium carbonate applications.

GMO and allergen free.

Can be used in all pH systems.

Claimed to confer superior performance coating characteristics, enhance visual appearance and texture of finished products.

Can simulate sugar without adding calories.

Figure1. Summary of Sensient Food Colors' titanium dioxide alternative with two food products made with it.

Sensient Food Colors: Opacity agent

Applications:

Panned applications, baking, confection, dry grocery, pet food. In addition, it can be used in beverages, dairy, sauces and condiments.

Developer Overview :

Sensient Colors, founded in 1922 and headquartered in St. Louis, US, makes natural and synthetic colors and dyes for food, beverage, pharmaceutical, cosmetic, personal, and home care product manufacturers. Sensient Colors portfolio includes the development of 1,000 color blends. The company has subsidiaries in Brazil, Canada, France, Germany, Italy, Mexico, Switzerland, and the UK.

Figure 2. Example applications using Avalanche.

References:

1. https://sensientfoodcolors.com/en-us/
2. https://sensientfoodcolors.com/en-us/color-solutions/avalanche/
3. https://sensientfoodcolors.com/en-us/research-development/two-new-solutions-replace-titanium-dioxide/
4. https://www.dairyfoods.com/articles/89921-sensient-colors-introduces-avalanche-a-titanium-free-opacity-agent

EXBERRY: Coloring Foods

Overview:

Coloring foods has recently emerged as an alternative to artificial coloration without involving the need for further chemical processing. Coloring Foods can deliver vibrant shades of color used for coloring food and drink products. Coloring foods fit the category of “clean labels,” and are to be listed as part of the ingredient list. Coloring foods are offered as powder and liquid and their shelf life expectancy can last up to 12 months (e.g., EXBERRY carrot-based yellow).

AT A GLANCE

EXBERRY®

https://exberry.com/en/
Contact form
Netherlands
200

SUMMARY

TYPE OF MATERIAL
Natural

SOURCE
Blends of fruits, vegetables, or edible plants

SCALE OF OPERATIONS
Sample request. Interested parties must fill in personal information and intended application

END PRODUCT USE
All food and beverages categories, including confectionery, dairy, bakery and savory applications.

EXBERRY: Coloring Foods

EXBERRY®

Technical Data:

The classification of “coloring food” is only regulated in Europe.

Coloring food represents a group of coloring ingredients derived from fruits, vegetables and edible plants and that are manufactured using a physical procedure without the addition of chemicals.

“Coloring Food” fits within the criteria of clean-label strategy. It can be reported on the ingredient labels (‘concentrates (strawberry, blueberry, etc)’ or ‘Coloring Food (concentrate of strawberry, blueberry)’. Coloring Foods, in the US, appear on ingredient labels as 'fruit and/or vegetable juice (for color).' Some food coloring, as is the case of EXBERRY are already patented.

Advantages:

Coloring food, as extracted from natural sources, offer the widest range of food coloring shades.

Provides color solutions for all categories of foods and beverages.

Ease of use, brilliance, performance and consumer-friendly labeling.

Offer long lasting shelf life (EXBERRY® Shade Yellow is pH independent, with good light and heat stability, and a 12-month shelf life at <25ºC).

Food coloring performs well when exposed to heat.

Figure 1. Exberry range of colors used in confection.

EXBERRY: Coloring Foods

Applications:

Bakery

Beverages, cereals and snacks

Confectionary, dairy, savory applications

Fillings and coatings, frozen desserts

Fruit prep

Supplements

Figure 2. Some of the Exberry coloring food applications.

References:

1. https://exberry.com/en/
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3. https://exberry.com/en/applications/
4. https://www.foodnavigator.com/Product-innovations/Explore-the-EXBERRY-R-Oil-Dispersible-range
5. https://www.confectionerynews.com/Article/2019/10/10/GNT-EXBERRY-Organics-range-of-Coloring-Foods-help-manufacturers-meet-clean-label-requirements

Potential Next Steps

- ✔ PreScouter can help conduct a thorough search for natural and clean-label food color opportunities with your technical and business parameters. This can be done for products that are already on the market, those close to commercialization and/or those in development.
- ✔ PreScouter can provide best-fit recommendations and down select top candidates from a landscape custom to your application.
- ✔ PreScouter can perform anonymous interviews with companies and researchers to glean additional insights regarding the development pipeline.

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Gareth has been with PreScouter since 2015, and specializes in the Food & Beverage and Life Sciences industries. Since joining the PreScouter team, he has worked across multiple topics ranging from product and process improvement and development, and sustainability throughout the food and beverage industry as well as healthcare. Gareth's research background at the University of Alberta is in the biochemistry of membrane proteins in health and disease. Prior to joining the PreScouter team, he was a project coordinator for the Cancer Research Institute of Northern Alberta (CRINA).

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Jorge supports PreScouter as an Advanced Degree Researcher helping provide clients with high-quality information and analysis about the latest insights into disruptive technologies, helping companies find new markets and remain competitive in their market niche. Jorge performs research in developmental and environmental sustainability in both developed and developing countries, using expertise acquired at the Universities of Florida and Syracuse (US), Ryerson, and Environmental and Climate Change Canada. Jorge holds a PhD in Biology and an MA in Conservation Biology.

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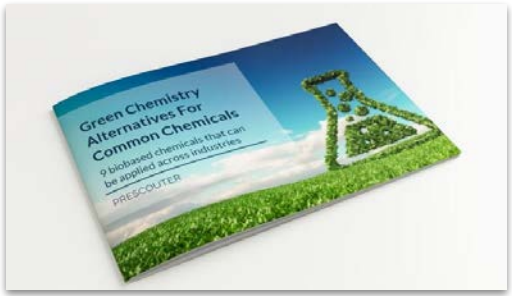

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