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BACTERIAL PIGMENTS AS FOOD COLOURANTS

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Introduction

Pigments produced by organisms as a reminiscence of their secondary metabolism are commonly mentioned as bio pigments. These bio pigments have extensive synthetic and commercial applications. Some act as antioxidants, others are UV protectors and numerous have antimicrobial properties. Bacteria, fungi, yeasts, algae and actinomycetes produce a wide range of pigments. Pigments are synthesized in the cell wall or periplasmic space. The global natural colour market represented 54.9% of the total food colour market in 2015. It is expected to increase to 60% by 2020 (Venil *et al*., 2020).

YEAR	DEVELOPMENT
1856	Perkin's mauve pigment was discovered and coaltar dyes were synthesized
1884	*Monascus sp* was cultivated and utilized in making red rice wine, red shoahsing wine and red Chinese rice
1954	The first carotenoid pigment from *Cryptococcus* was marketed
1963	Production of carotenoid pigments from *Rhodotorua sp* started
Early 1970's	Astaxanthin was isolated from *Phaffia rhodozyma* grown on exudates of deciduous trees in Japan and Alaska
Late 1970's and early 1980's	Production of beta-carotene from *Dunaliella salina* took place
1985	Betatene limited corporation was established for the cultivation of *D.salina* on large scale for producing natural beta-carotene products

Advantages

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- Easy and fast growth in cheap culture medium
- Independent of weather conditions.
- Grow rapidly
- Pigments confer heavy metal resistance

Disadvantage

- Sensitive to heat, light, acidity, air and water activity.
- Easily degradable.

Functions of microbial pigments

- Protection from UV rays
- Act as antioxidant
- Protect from extreme heat and cold
- Functions as antimicrobial and anticancer
- Acquisition of nutrients like iron, nitrogen and carbon.

MICROORGANISM	**PIGMENTS**
1)Bacteria	
-*Achromobacter*	Creamy
-*Bacillus sp*	Brown
-*Brevibacterium sp*	Orange, yellow
-*Corynebacterium michigannise*	Greyish to creamish
-*Pseudomonas sp*	Yellow
-*Rhodococcus maris*	Bluish red
-*Streptomyces sp.*	Yellow, red, blue
2)Molds	
-*Aspergillus sp.*	Orange, red
-*A.glaucus*	Dark red
-*Blakeslea trispora*	Cream
-*Helminthosporium catenarium*	Red colour
-*H.gramineum*	Red

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-*H.avenae* -*Monascus purpureus* -*P.cyclopium*	Bronze colour Yellow, orange, red orange
3)Algae -*Dunaliella salina*	 Red
4)Yeasts -*Phaffia rhodozyma* -*Rhodotorula sp.*	 Red Red

BACTERIAL

- **Prodigiosins**- *Serratia marcescens* and *Hahella chejuensis etc*.
- **Pyocyanin**- *Pseudomonas aeruginosa*
- **Phycocyanin**- *Arthrospira platensis*
- **Violacein**- *Chromobacterium violaceum*
- **Canthaxanthin**- *Paracoccus carotinifaciens, Rhodococcus maris, Corynebacterium sp.*
- **Lycopene**- *Streptomyces chrestomyceticus* subsp *rubescens*
- **Zeaxanthin and lutein**- *Flavobacterium* sps.
- **Astaxanthin** – *Agrobacterium aurantiacum*
- **Flexirubin**- *Chryseobacterium*
- **Actinomycetes pigment- Rubrolone:** A water soluble purple red pigment complex produced by *Streptomyces echinoruber*

Prodigiosin: It is a multipurpose red pigment; a typical alkaloid compound produced by microorganisms such as *Serratia marcescens, Vibrio psychoerythrus, Rugamonas rubra* Actinomycetes- *Streptoverticillium rubrireticuli.* It has limitations such as sensitivity, solubility and short stability to pH, temperature and light. These particles were applied to yogurt, milk and carbonated drinks (Venil *et al*., 2014).

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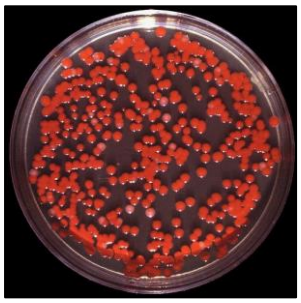
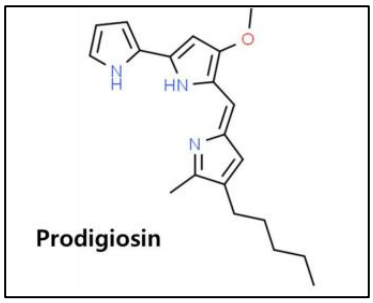
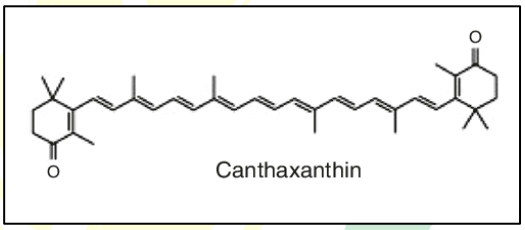
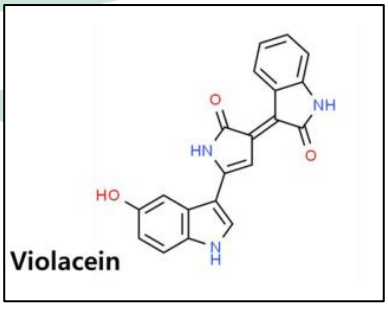




Canthaxanthin: Canthaxanthin is made commercially from beta carotene. Orange and dark pink pigment**.** Produced by bacteriochlorophyll containing *Bradyrhizobium* (photosynthetic) strains isolated from stem nodules of *Aeschynomene* species and *Halobacterium* sp**.** Canthaxanthins are effective antioxidants and inhibit the oxidation of lipids in liposomes**.** First isolated from edible mushrooms. Added to trout feed, salmon feed, poultry feed.



Violacein: It is a versatile pigment from the bacterium *Chromobacterium violaceum* that exhibits numerous biological activities. Violacein is a purple diindole-pyrrole pigment derived from tryptophan. It has gained immense importance in industrial markets, such as in medicine, cosmetics, food and textiles (Dufossé, 2018).



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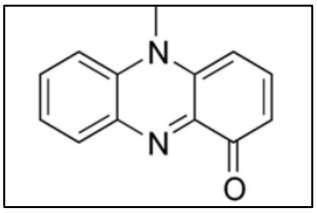
Pyocyanin: Bluish green phenazine produced by *P.aeruginosa.* Pyocyanin is a highly reactive metabolite which, being toxic to mammal cells, cannot be used in foods. Priorly used in clear Pepsi cola and Bacardi Breezer, the colour retained up to 1 month at room temperature.



Phycocyanin: It is a blue pigment, produced by Cyanobacteria (dried *Arthrospira platensis*) which contain chlorophyll a. Requirement- 140 to 180 mg/kg. Colour additive in candy and chewing gum.

Conclusion

As the demand for natural, organically clean label products grows in the food and beverage industry, so does the demand for natural ingredients. Microbial colourants are compounds in industrial products that are offered to the food industry as a natural alternative. Natural colour use in functional, beverage, food and bridging applications necessitates an awareness of a number of features and ideas, including heat and light stability, as well as the capacity to offer vibrant colour tints. Because the market for bacterial pigment products is so enormous for future applications, environmentally safe and cost-effective bacterial pigment production has a lot of potentials.

References

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