

Type of the Paper (Review)

Microbial aryl carotenoids as bioactive food ingredients

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Abstract: Carotenoids are key compounds among bioactive food ingredients as they can act as colorants, antioxidants, and pro-vitamine A for some. They are suggested to play a role in the prevention of degenerative diseases. Focus is put here on aryl carotenoids which are only produced by microorganisms in Nature and are of special interest as they combine a polyenic chain with phenolic group(s).

Keywords: carotenoid; aryl carotenoid; multifunctional carotenoid; isorenieratene

1. Introduction

Microorganisms play a major role in the production of food ingredients. Among the compounds which are produced by bacteria, yeasts and fungi are some thickening and gelling agents (e.g. xanthan), flavor enhancers (e.g. yeast extracts), acidulants (e.g. lactic acid), or flavors (e.g. gamma-decalactone with a peach-like aroma). Pigments and colorants started to be produced through microorganism cultivation a long time ago in Asia (red pigment from the fungus *Monascus*) and more recently in Europe (1995, β -carotene from the fungus *Blakeslea trispora*). Among the pigment family, carotenoids gain special interest as they are coloring agents (yellow-orange-red-purple) with some health properties mainly linked to their antioxidant activities. Consumption of carotenoid-rich foods is beneficial to human health and a lot of research has been done with molecules such as β -carotene, lutein, lycopene, zeaxanthin, astaxanthin... [1]. This short review emphasizes carotenoids that are only produced by microorganisms, not by plants. These carotenoids are named aryl carotenoids or aromatic carotenoids.

2. Aryl carotenoids are specific to some microorganisms

Aryl carotenoids such as isorenieratene and hydroxyl derivatives (Figure 1) are produced by a very small number of microorganisms. Some are anaerobic and photosynthetic (Chlorobiaceae, Chromatiaceae...). Non photosynthetic bacteria are easier to use and aryl carotenoid occurrence was reported in *Brevibacterium linens* (Figure 2), *Streptomyces mediolani* and *Mycobacterium aurum*, all belonging to Actinomycetales, an order of Actinobacteria.

Figure 1. Aryl carotenoids described in *Brevibacterium linens*.

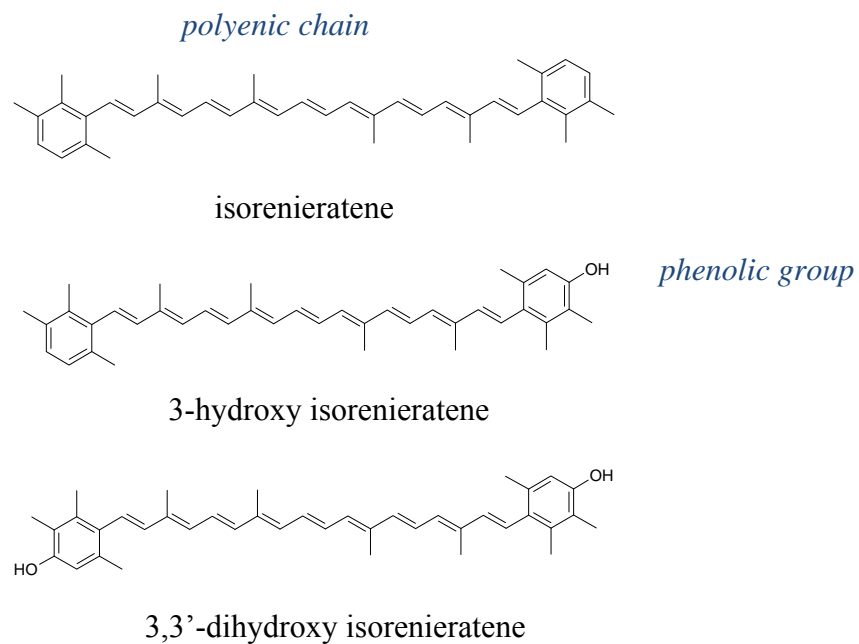
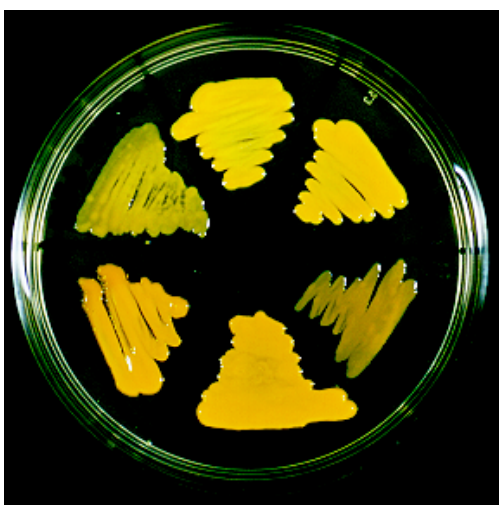


Figure 2. Production of aryl carotenoids by *Brevibacterium linens* on a Petri dish (a) and on Livarot cheeses (b).



(a)



(b)

The main interest of *Brevibacterium linens* is that this bacterium is part of the microflora of smear-ripened cheeses [2-5]. This could facilitate the use of carotenoids derived from the bacterial biomass as food ingredients. Up to now, levels of production in liquid media are however limited to 0.50-1.0 mg per liter [6-8], a concentration of aryl carotenoids too low to envisage an industrial production.

3. Health properties of aryl carotenoids

When tested among carotenoids including astaxanthin, β -cryptoxanthin, zeaxanthin and lutein, 3,3'-dihydroxyisorenieratene (DHIR) proved to be a superior, a "top of the list" antioxidant (best radical scavenger and singlet oxygen quencher) [9-13]. The experimental data obtained through various antioxidative activity tests suggest that DHIR acts as a bi-functional radical scavenger owing to its polyenic and phenolic sub-structures.

4. Conclusions

Aryl carotenoids have been studied for some years now. Their microbial production using *Brevibacterium linens*, a food-grade bacterium, is well known however the concentration in the culture medium is not high enough for commercialization at a price that could be accepted by the market. Chemical synthesis is an alternative for the short and medium terms. A chemical company, i.e. BASF, developed a new synthesis [10, 12], academics did the same [14], but aryl carotenoids such as isorenieratene or DHIR are not yet available for large scale uses. Molecular biology could be an alternative to obtain affordable polyenic-phenolic carotenoids [15] which proved interesting properties as bioactive food ingredients (superior antioxidants).

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Conflict of Interest

The authors declare no conflict of interest.

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