

Carotenoids from *Blakeslea trispora*

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Abstract

Blakeslea trisporais mold, from division Zygomycota. This specie is known for its capacity to produce carotenoids, beta carotene and lycopene etc. These pigments are valuable food coloring agents that might have beneficial impacts for human wellbeing such as antioxidants. Presently, *Blakeslea trispora* is utilized to fabricate β -Carotene and astaxanthin on large scale that is used as a source of provitamin A or retinol and food additive in animal/aquaculture feed respectively. In addition, carotenoid including lycopene, phytoene and phytofluene are also obtained from *Blakeslea trispora*. Among all carotenoids, β -Carotene is also used for numerous clinical purposes such as in preventing cardiovascular diseases and cancer, inducing apoptosis in tumor cells, stimulating body's immune system, and provides protection against reactive oxygen species (ROS). In addition, β -Carotene is widely incorporated in cosmetics and body-care products. Besides β -Carotene is a significant carotenoid that moreover utilized as a feedstock additive in foods formulated for domestic pets.

Keywords

β -Carotene, Lycopene, Retinol, Vitamin A, Biosynthesis

1. Introduction

Blakeslea trispora is a mold fungus placed with the division Zygomycota that can possibly produce carotenoids, for example, β -Carotene and its forerunner lycopene the two of which assumes a significant part in suppressing oxidative stress [1, 2]. *Blakeslea trispora* was first isolated from the soil of Southern United States and Southern Asia [3]. It goes through both sexual and asexual mode of reproduction to produce zygospores and sporangiospores respectively [4, 5]. In vivo pathogenicity proposes *Blakeslea trispora* as non-pathogenic towards animal and humans [6].

2. *Blakeslea trispora* as a source of Carotenoids

Blakeslea trispora plays a significant role in modern industry by producing β -Carotene and its precursor lycopene that are well known antioxidants and food pigments [7, 8]. Carotenoid additionally called terpenoids displays yellow, orange or red colors that are mostly produced by plants, algae and some fungi [9]. Carotenoids give color to flamingo, tomatoes, rose etc [10]. In addition, terrestrial arthropods including aphids, spider and mites are known to produce carotenoids [11]. Assimilation of carotenoid is improved when consumed with fat [12]. There are approximately 1100 known carotenoids which can be additionally sorted into two classes namely xanthophylls (which contain oxygen) and carotenes (which are absolutely hydrocarbon and contain no oxygen) [13, 14]. In non-photosynthetic fungus, carotenoid is orchestrated in specific mycelia described by the presence of lipid globules [15]. Market worth of carotenoid produced from *Blakeslea trisporais* estimated to be 1.5 billion dollars in 2019 and is projected to arrive at 2.0 billion dollars in 2026 [16]. Despite the fact that carotenoids produced by synthetic combination rules the worldwide market [17]. Consumers interest for regular and natural product is the main impetus for the natural carotenoid production which is developing quickly with yearly pace of 4% for the period 2016-2023 [18]. The practicality of bioprocess is impacted by the assembling and commercialization expenses of end product and its planned use [19]. Process developments concerning microbial upgrading of buildups and squanders for carotenoid production will diminish the fabricating expenses

and make it more environment friendly [20].

3. Types of carotenoids produced by *Blakeslea trispora*

- Lycopene
- Phytoene
- Phytofluene
- β -Carotene [21, 22]

Lycopene: Lycopene is an intermediate carotenoid used in the biosynthesis of β -Carotene [23]. Lycopene cyclase, a compound is utilized to hinder the cyclization response of lycopene which will prompt the development of β -Carotene [24]. For the biosynthesis of lycopene, *Blakeslea trispora* is developed with lycopene cyclase inhibitor which can be brought into the fermentation cycle [25]. To orchestrate lycopene, *Blakeslea trispora* requires both mating strains for example (+) and (-), lycopene is separated from biomass and afterward recovered through filtration and crystallization [26].

Clinical utilizations of lycopene

- *Blakeslea trispora* powder that contains high measures of lycopene has the potential to safeguard liver, brain, kidney, and skin against oxidative stress [27].
- Additionally, lycopene is utilized to treat atherosclerosis [28].
- Lycopene plays its role in oxidative stress reduction and cardiovascular protection by reducing arterial toughness by neutralizing reactive oxygen species [29].

Phytoene and Phytofluene: Phytoene and Phytofluene are transparent carotenoid, tracked down in natural fruits and vegetables [30]. Rather than other carotenoids the phytoene and Phytofluene, the main carotenoid antecedents in the biosynthetic pathway of carotenoids retain light in the UV range [31]. Phytoene and Phytofluene are viewed as in number of human tissues including liver, lung, breast, prostate skin etc [32, 33].

β -Carotene: Carotenoids plays a vital nourishing role in human diet as a source of vitamin A [34]. Out of 50 types of carotenoids, β -Carotene are referred as reddish orange food additive as it supplements vitamin A in food products [35]. β -Carotene are unsaturated isoprene derivatives, first isolated by Wackenroder in 1831 [36]. β -Carotene production by *Blakeslea trispora* occurs in two stages [37]:

Stage I: Glucose and corn steep alcohol can be utilized as a source of nitrogen and carbon [38]. Whey, produced during cheddar producing process has likewise been utilized alongside strains to use lactose [39]. During the underlying aerobic submerged fermentation process, fungal biomass is produced that is profoundly rich in β -Carotene [40].

Stage II: Second stage includes β -Carotene recovery in which it is separated from biomass when extricated with ethyl acetic acid, purified and solidified [41]. The final product is either utilized in translucent structure or by shaping a suspension of micronized crystals in vegetable oil [42].

Clinical utilizations of β -Carotene

- Used for preventing cardiovascular diseases and cancer [43]
- Induces apoptosis in tumor cells [44]
- An antioxidant in protection against reactive oxygen species (ROS) [45].
- Stimulates immune system and it also plays significant role in prevention of degenerative diseases [46].
- The significance of beta carotene as a source of provitamin A which changes over into vitamin A (retinol) to combat eye diseases, such as cataracts and night blindness, various skin diseases such as acne etc [47].
- β -Carotene is likewise utilized in cosmetics and body-care items as a colorant that has no destructive secondary effects but to upgrade the engaging quality of the item [48].
- β -Carotene due to its ability to give specific color has been utilized in extensive variety of food and drink items to further develop their variety such as cheddar, natural product juices, dairy items, and canned food etc [49].
- β -Carotene is a significant carotenoid that moreover is utilized as a feedstock additive for pets, for example, canines, felines and birds [50].

4. Conclusion

Thus, *Blakeslea trispora* is a natural source for numerous carotenoids of which lycopene and β -Carotene holds huge industrial importance since these pigments are widely used as food additives and as antioxidants.

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