PROVA 1 GABARITO-ESPELHO

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Leia o texto abaixo e responda as questões.

Molecular Characterization of Fungal Pigments

by Miriam S. Valenzuela-Gloria, Nagamani Balagurusamy, Mónica L. Chávez-González, Oscar Aguilar, Ayerim Hernández-Almanza and Cristóbal N. Aguilar

I. At present, the colorants are employed by various industrial sectors such as textiles, pharmaceuticals, nutraceuticals, and most importantly as an additive in the food industry. The use of colorants by food products contributes widely to the visual impact to gain the attention and preference of the consumer, apart from adding value to the product. The use of these agents has a number of disadvantages, including a lack of raw materials, differences in pigment extraction, and, most notably, the environmental effect of chemical syntheses used in the production of these additives. Recently, research has been focusing on the quest for new natural sources, and which has thrown up a myriad of potential sources such as plants, animals, bacteria, microalgae and even fungi.
II. Pigments derived from microbes have many benefits over those derived from plants or animals, including low environmental effects, viability, profitability, and ease of handling prior to, during, and after processing. Fungi stand out among microorganisms of interest because of their ability to produce a broad spectrum of soluble pigments under a variety of conditions and substrates. Because of their ease of cultivation in the laboratory and comparatively lean downstream operations that are readily scalable at pilot or plant scales, pigments extracted from filamentous fungi have piqued industrial interest.
III. Fungal pigments have the capacity to be a significant source of bio pigments due to their high yield potential and ease of extraction. For example, the biomass production of *Chlamydomonas reinhardtii* microalgae oscillates in the range of 2.0 g L^{-1} in dry biomass, whereas the biomass production of a filamentous fungus such as *Mucor circinelloides* oscillates in a radius of 4.0 g L^{-1} in dry biomass. About the fact that all previous values are in crops without optimization assessment, it is possible to find a 1:2 relationship in the production of dry biomass. According to Zhang et al., *Monascus* will increase its yields from 48.4 to 215.4 mg L^{-1} by optimizing the glutamic acid present in the culture

medium, which is equal to a 1:3.5 ratio. As a result, understanding and characterizing the molecular structure of these pigments for safe and sustainable use becomes critical if mass application is intended.

IV. In general, the qualitative nature of the pigments is studied using comparative charts, or colorimeter or by use of spectrophotometry. However, qualitative colour assessment only helps one to make assumptions; therefore, understanding and investigation of pigments at the molecular level are needed for later use.

V. Fungi are one of the kingdoms of the Eukarya domain that can be found in almost any climate, especially in terrestrial ecosystems. They play an important role in the nitrogen cycle because they are scavengers, decomposers, predators, pathogens, and even parasites, and they can survive in symbiotic relationships with plants, algae, and animals, among others. Some fungi genera have grown in importance over time due to their ability for industrial applications.

VI. Fungi, especially filamentous fungi, have gained popularity due to their ability to produce a diverse range of secondary metabolites that are important in the health, food, agricultural, and other sectors. Biopigments are one of them, and they are being studied because of their biodegradable nature, low production costs, wide range of colours, and biological properties ranging from antioxidants to anticancer. Most fungi produce water-soluble pigments that are suitable for industrial production since they are easy to scale-up in industrial fermenters and can be extracted without the use of organic solvents.

VII. Some of the most important fungal species or genera for pigment production are found in the families, they are as follow: *Monascaceae, Trichocomaceae, Nectriaceae, Hypocreaceae, Pleosporaceae, Cordycipitaceae, Xylariaceae, Chaetomiaceae, Sordariaceae, Chlorociboriaceae, Hyaloscyphaceae, Hymenochaetaceae, Polyporaceae, Ophiostomataceae, Tremellaceae, Neurosporaceae*, and *Tuberaceae*. These metabolites are generated by *Monascus* spp. in general through the polyketide pathway, which is directly linked to fatty acid biosynthesis. Though, *Neurospora* spp. does so through the carotenoids' biosynthetic pathway. *Monascus* spp. is commonly used as a model fungus for the assessment of its biosynthetic pathway at the pilot level; but, owing to its difficulty, it has not yet been completely elucidated. On the other hand, some species, such as *Fusarium* spp., can produce pigments through the polyketide and carotenoid biosynthetic pathways shows several fungal species and their pigment production.

VIII. Obtaining pigments from natural sources is an activity that has been done for a long time, and in recent years has proven to be a great solution to avoiding the environmental impact caused by the production of synthetic colorants. Some of the most widely isolated and used natural pigments are carotenoids, anthocyanins, chlorophylls, phycobiliproteins, betalains, and

also quinones. The natural origins of these pigments are diverse; however, microorganisms emerge due to their ease of cultivation and extraction, as well as their large genetic diversity.

IX. Because of their high pigment production yields, fungi have managed to gain a notable position within the diverse range of microorganisms' pigment producers. Which fungi produce in the form of secondary metabolites under various stress conditions. Fungal pigments can be categorized as carotenoids or polyketides depending on their chemical composition. The fungal polyketides are made up of tetraetides and octaetides, which form eight C_2 units to form the polyketide chain, while carotenoids are made up of terpenoids, which comprise forty carbons in their main chain.

X. Certainly, the market for chemical-free pigments has increased significantly in industry and science. As a result, the extraction from biological origin has gained scientific interest, resulting in alternative processing and extraction from different strains of fungi. Since these have a number of significant advantages, such as low processing costs, high yields, and strong adaptability to shifting substrates, the exploitation of agro-industrial waste has emerged. This is how fungi are able to be considered sustainable industries for the production of pigments, where substantial progress has been made in the optimization of these processes by study and the implementation of different experiments. It is well known that different species of fungi collected from natural sources have a diverse chromatographic spectrum of pigments that are closely linked to a number of biological activities of importance, such as the antioxidant activity present in some pigments. Despite the fact that the area of optimizing processes that produce fungal pigments is progressing at a rapid pace. Another collection of investigations and projects is devoted solely to the structural, magnetic, and interactional information of them, i.e., their classification at the molecular level of fungal pigments, in which a variety of techniques are used, either individually or collectively. To introduce these to a large scale, they must be not only commercially feasible, but also safe, harmless, and controlled.

XI. As a result, society is becoming more mindful of the environmental and health harm that chemically synthesized pigments can cause. The manufacture of fungal pigments has taken a big step forward. However, it is already safe to state that said development is in progress but, due to production conditions, it has not been possible to completely cover existing consumer demand. Thus, achieving total availability by other means is one of the industry's biggest obstacles. For example, the discovery and investigation of other genera and/or species of fungi that have been underutilized due to ignorance of the existence of their secondary metabolites, which can be elucidated by either of the previously described techniques thus ensuring optimal process optimization.

(Extracted and adapted from: https://www.mdpi.com/2309-608X/7/5/326/htm)

As questões de 1 a 5 são de múltipla escolha. Para cada questão será aceita apenas uma resposta. (Cada questão vale 6, totalizando 30 pontos de 100)

1) De acordo com o parágrafo I, está correto afirmar:

a) No presente momento, vários corantes são empregados apenas na indústria têxtil e farmacêutica.
b) O uso de corantes tem contribuição restrita ao visual dos produtos.
c) <u>Um dos pontos negativos do uso de corantes é o efeito no meio-ambiente causado pela produção de tais aditivos.</u>
d) As pesquisas iniciais focaram, especificamente, na produção natural de novos aditivos naturais.
e) As pesquisas mais recentes foram canceladas devido ao pouco potencial de fontes encontrado em plantas e bactérias.

2) Segundo o parágrafo II, indique a única opção correta:

a) <u>Os fungos destacam-se, entre outros microrganismos, devido a sua habilidade de produzir um espectro amplo de pigmentos solúveis em uma variedade de condições e substratos.</u>
b) Os fungos despertam, entre outros microrganismos, uma ampla habilidade de produzir pigmentos mais solúveis de acordo com as condições de substratos.
c) Os fungos estão acima dos outros microrganismos na produção de pigmentos e substratos em condições menos variadas.
d) Os fungos sobrepõem-se aos demais microrganismos por terem mais habilidade de variação de substratos solúveis em pigmentos de amplo alcance.
e) Os fungos predominam, entre outros microrganismos, na produção de pigmentos de variação ampla com substratos solúveis.

3) De acordo com o parágrafo III, o que é correto afirmar sobre os pigmentos provenientes de fungos?

a) Eles têm uma significante capacidade de produzir pigmentos apesar da sua baixa extração.

b) Eles têm a capacidade de extrair pigmentos biológicos devido à alta capacidade de recursos de produção.
c) <u>Eles são uma fonte significante de pigmentos biológicos por terem um alto potencial de produção e fácil extração.</u>
d) Eles são capazes de aumentar a extração das fontes de pigmentos biológicos devido ao alto desempenho produtivo.
e) Eles têm uma significante capacidade de produção em fontes de pigmentos biológicos de fácil extração.

4) Indique a opção correta de acordo com o parágrafo IV.

a) A avaliação quantitativa de cor permite apenas que se façam suposições sobre a natureza dos pigmentos.
b) <u>A avaliação qualitativa da cor contribui apenas com suposições em estudos comparativos.</u>
c) A qualidade da avaliação da cor extraída dos fungos ajuda no estudo mais aprofundado sobre a natureza do pigmento obtido.
d) A afirmação de que a natureza do pigmento contribui pouco para estudos comparativos é falsa.
e) A quantidade de pigmento obtido de forma natural contribui unicamente em estudos comparativos.

5) Sobre os fungos, o que afirma o parágrafo V?

a) Os fungos ocorrem apenas em ecossistemas terrestres.
b) Por serem necrófagos, os fungos sobrevivem a qualquer situação climática.
c) Alguns tipos de fungos não podem ser utilizados em escala industrial.
d) O papel fundamental dos fungos ocorre no ciclo de nitrogênio.
e) <u>Os fungos podem sobreviver simbioticamente com plantas, algas e animais.</u>

Responda as questões a seguir em língua portuguesa. (Cada questão vale 8, totalizando 40 pontos de 100)

6) De acordo com o parágrafo VI, qual a razão dos estudos sobre os pigmentos biológicos?

(...they are being studied because of their biodegradable nature, low production costs, wide range of colours, and biological properties ranging from antioxidants to anticancer.)

Devido a sua natureza biodegradável, baixo custo de produção, ampla variedade de cores e propriedades biológicas desde antioxidantes a anticancerígenos.

7) Qual a importância do *monascus purpureus* na produção de pigmento, segundo o parágrafo VII?

(Monascus spp. is commonly used as a model fungus for the assessment of its biosynthetic pathway at the pilot level; but, owing to its difficulty, it has not yet been completely elucidated.)

É comumente usado como um modelo de fungo para avaliação de sua via biossintética no nível piloto; mas, devido a sua dificuldade, ainda não foi completamente elucidado.

8) O que a obtenção de pigmentos naturais tem provado nos últimos anos (parágrafo VIII)?

(... to be a great solution to avoiding the environmental impact caused by the production of synthetic colorants.)

Ser uma ótima solução para evitar o impacto ambiental causado pela produção de corantes sintéticos.

9) Como podem ser categorizados os pigmentos fúngicos (parágrafo IX)?

(... as carotenoids or polyketides depending on their chemical composition.)

Como carotenoides ou polyketides dependendo da sua composição química.

10) De acordo com o parágrafo X, qual é o resultado do aumento industrial e científico do mercado de pigmentação sem produtos químicos?

(... the extraction from biological origin has gained scientific interest, resulting in alternative processing and extraction from different strains of fungi.)

A extração de origem biológica ganhou interesse científico, resultando em processo e extração alternativos de diferentes cepas de fungos.

Tradução –

Converta para o português a passagem a seguir extraída do texto em questão (total de 30 pontos de 100):

As a result, society is becoming more mindful of the environmental and health harm that chemically synthesized pigments can cause. The manufacture of fungal pigments has taken a big step forward. However, it is already safe to state that said development is in progress but, due to production conditions, it has not been possible to completely cover existing consumer demand. Thus, achieving total availability by other means is one of the industry's biggest obstacles. For example, the discovery and investigation of other genera and/or species of fungi that have been underutilized due to ignorance of the existence of their secondary metabolites, which can be elucidated by either of the previously described techniques thus ensuring optimal process optimization.

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Como resultado, a sociedade está se tornando mais consciente dos danos ambientais e à saúde que os pigmentos sintetizados quimicamente podem causar. A fabricação de pigmentos fúngicos deu um grande passo em frente. No entanto, já é seguro afirmar que o referido desenvolvimento está em curso mas, devido às condições de produção, não foi possível cobrir totalmente a procura de consumo existente. Assim, alcançar a disponibilidade total por outros meios é um dos maiores obstáculos da indústria. Por exemplo, a descoberta e investigação de outros gêneros e / ou espécies de fungos que foram subutilizados devido ao desconhecimento da existência de seus metabólitos secundários, o que pode ser elucidado por qualquer uma das técnicas descritas anteriormente, garantindo assim a otimização ideal do processo.