MONASCUS PIGMENTS AND CITRININ

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Introduction

Natural pigments, like those from Monascus species, are valued for their vibrant colors and sustainability. Their potential, however, faces obstacles in production optimization and minimization of toxins.

Objectives

- To investigate the biosynthesis of Monascus pigments (MPs).
- To review methods to increase MPs production during fermentation by optimizing medium conditions and nutrients.
- To examine different techniques for extracting and purifying MPs.
- To analyze the biotoxicity of citrinin, its biosynthetic pathway, and strategies to reduce or eliminate it.

Biosynthesis and gene clusters

The Monascus pigments, which include yellow, orange, and red varieties, are secondary metabolites with potential use as food colorants. The production of these pigments involves a polyketide synthase (PKS)-dependent pathway. The genes that encode the enzymes responsible for the pigment assembly are found in clusters in the Monascus genome.

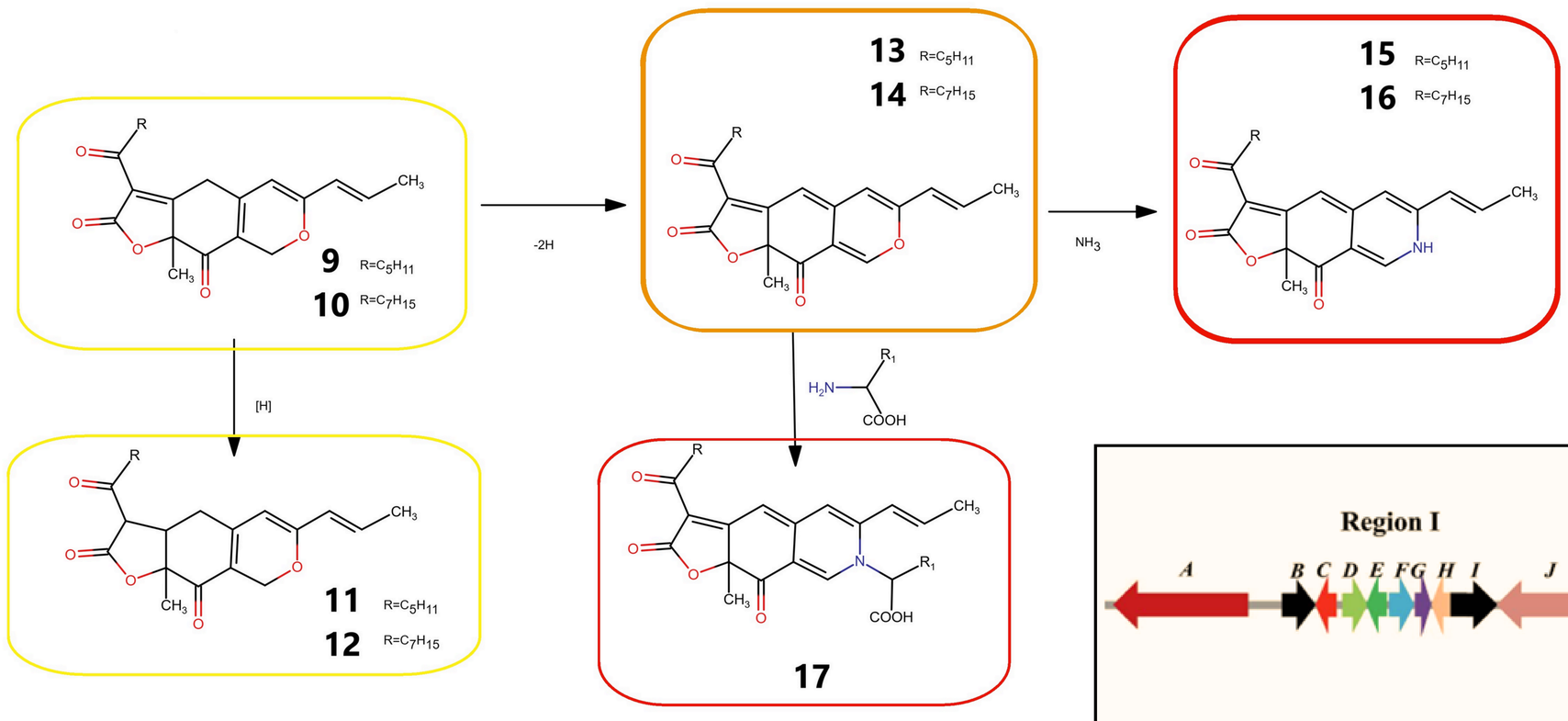

Fig 1: Main MPs. Each pigment is outlined by its respective color. Sources: Kang et al., 2013; Chen et al., 2017; Liang et al., 2018; Liu et al., 2018

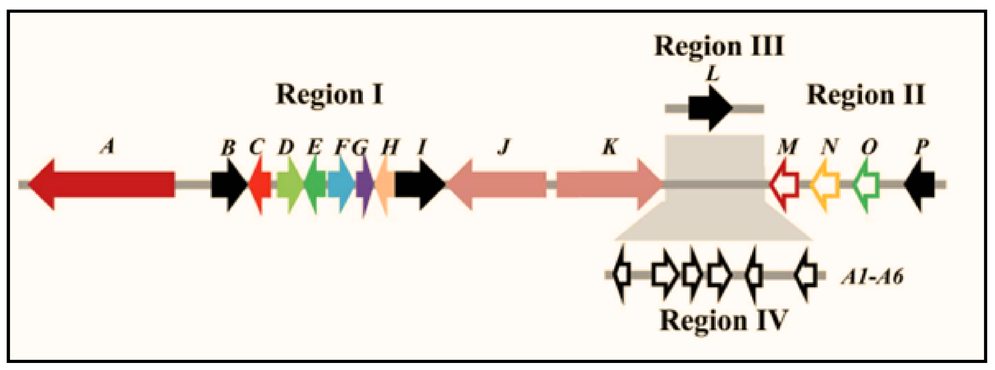

Fig 2: MPs biosynthetic gene cluster. Source: Chen et al., 2017

Optimizing Pigment Production

HIGHEST ORANGE/YELLOW PIGMENT YIELD

- pH 2.5
- Ethanol as carbon source

HIGHEST RED PIGMENT YIELD

- pH 6.5
- Mannitol as carbon source

OTHER GENERAL CONDITIONS

- Absence of light
- NH4Cl as nitrogen source

Citrinin

Mycotoxin with nephrotoxic and hepatotoxic activities, co-produced with MPs due to a similar biosynthetic pathway.

Means for reduction or elimination:

- Low pH (2.5)
- NH4Cl as a nitrogen source

There have been recent breakthroughs for obtaining genetically modified strains without citrinin production (not yet developed).

Conclusion

Monascus species represent a sustainable alternative to synthetic food colorants due to their ability to produce natural pigments. However, the co-production of citrinin remains a challenge. Ongoing research into its biosynthesis and mitigation strategies is crucial for ensuring the safe industrial use of these pigments. Further optimization of fermentation conditions, purification methods and genetic engineering tools will enhance pigment production while minimizing citrinin contamination.