Biodegradability of the residual streams of colorants production

Introduction

Pigments are secondary metabolites produced by fungi during antagonistic environment conditions.

Xylindein is a blue-green pigment secreted by the wood-staining fungi *Chlorocioria aeruginosa* (Figures 1 and 2).

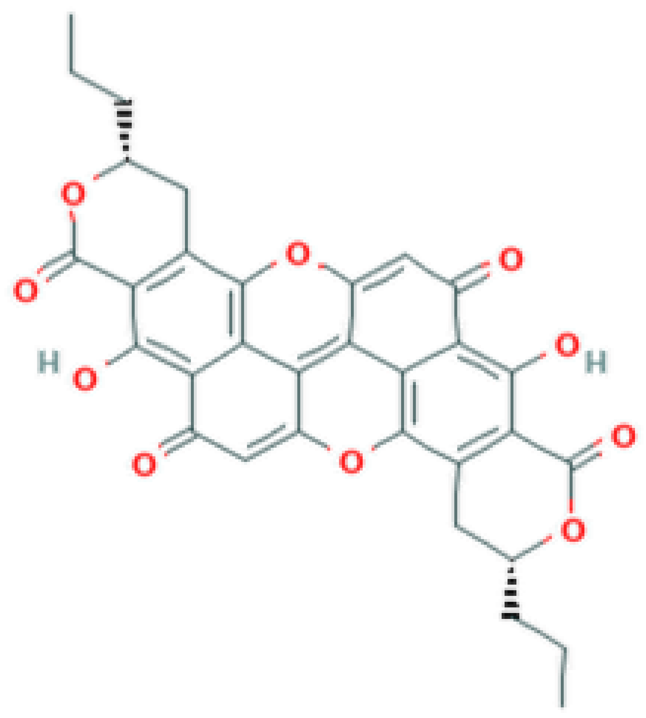

Figure 1: The chemical structure of Xylindein.

Figure 2: The fungi *Chlorocioria aeruginosa* in nature.

Azaphilone is a red pigment produced by *Penicillium purpurogenum* (Figures 3 and 4).

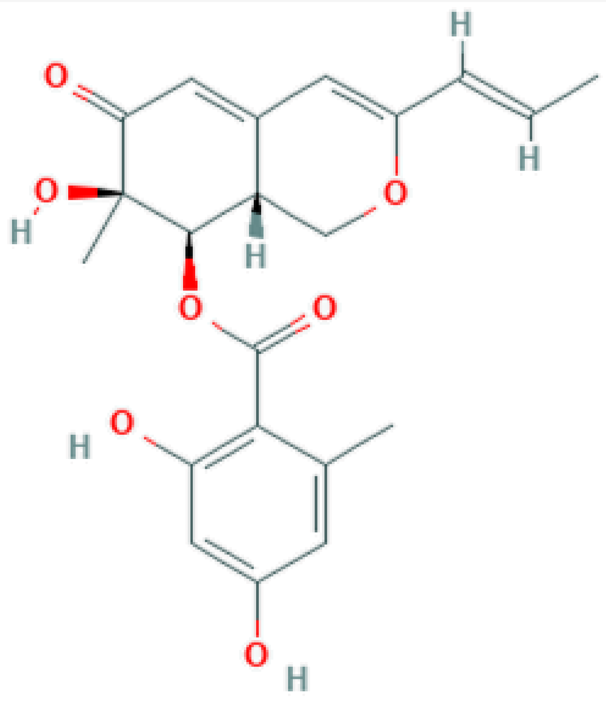

Figure 3: The chemical structure of Azaphilone.

Figure 4: *Penicillium purpurogenum* showing extracellular pigment production.

The aim of this project is to test if these pigments' residual streams produced through fermentation are biodegradable.

Methods

First, Chemical oxygen demand (COD) was analyzed with Spectrophotometer. To determine the biodegradability of the samples Oxitop respirometers (Figure 5) were used.

Figure 5: Oxitop bottle with respirometric BOD System.

- The medium is mixed with sludge containing microbes, which consumes the sample.
- The microbes use oxygen and carbon originating from the sample to produce CO_2.
- This CO_2 absorbed causes a drop in pressure which is used to calculate biological oxygen demand (BOD).

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Results

First, different reference concentrations were tested, glucose and fructose in a ratio of 2:1, the results showed that 5 mL can be used. Table 1 shows the concentration used in every experiment afterward and the samples tested.

Sludge (mL)	Medium (mL)	Sample (mL)	Total in the bottle (mL)
1 mL	159	5	165

Sample	Sample content
S1 and S3	Supernatant after fermentation of xylindein
S2	Xylindein extracted from the supernatant with Dichloromethane
Reference	Glucose and fructose
Azaphilone	Supernatant after fermentation

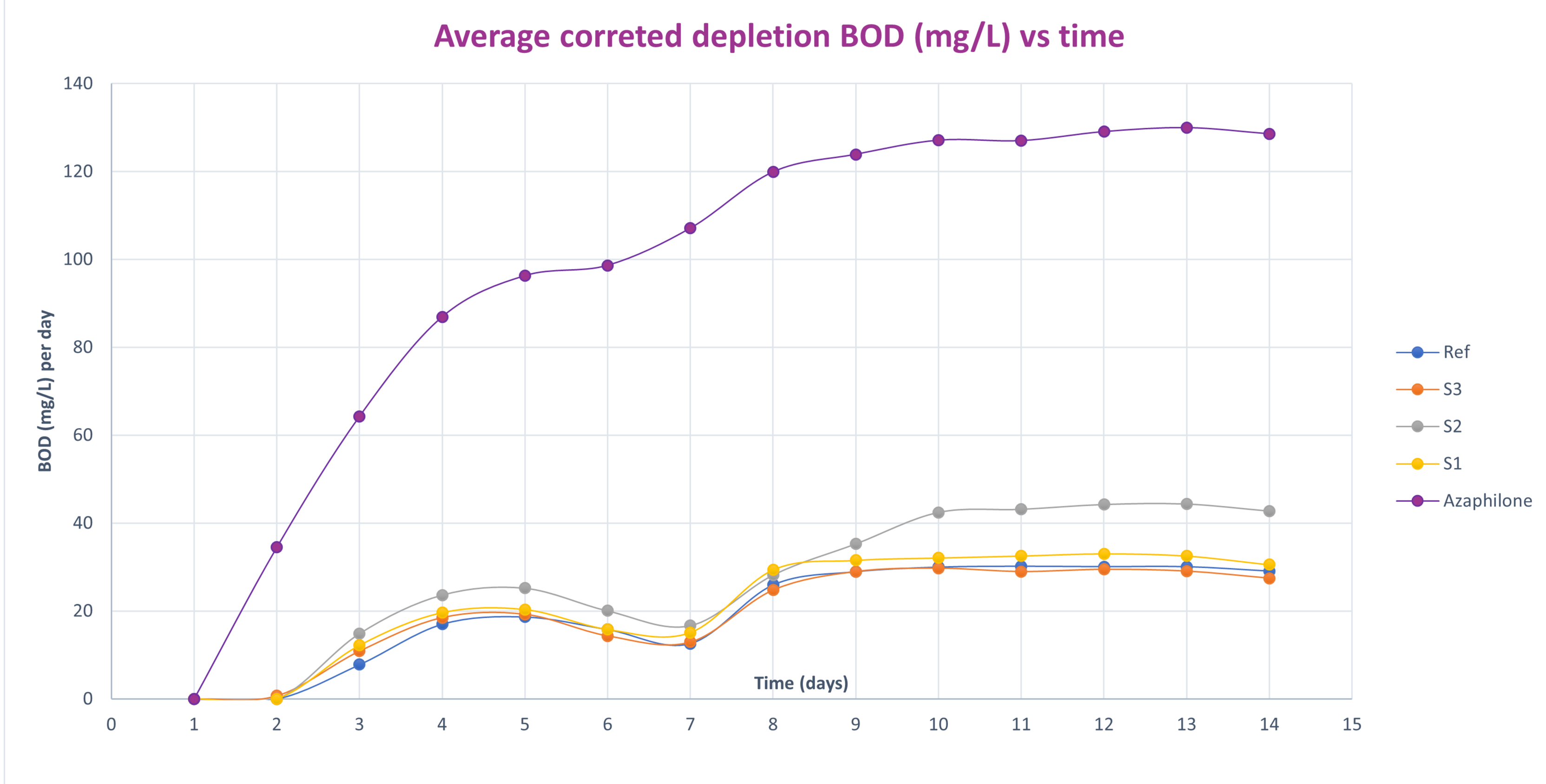
Table 1: Standardization of concentrations for the samples tested in Oxitop and samples tested.

Table 2 shows the calculations using the obtained COD results.

Sample	COD (mg/L)	BOD_{14} (mg/L) x Dilution factor	BOD_{14}/COD
S1	4212	1008	0,24
S2	1468	1410	0,96
S3	2078	905	0,44
Azaphilone	7295	4242	0,58

Table 2: COD (mg/L) values, BOD14 (mg/L) multiplied with dilution factor, and the BOD (mg/L) dived by COD (mg/L).

Graphic 1 shows Biological Oxygen Demand (BOD) in mg/L for 14 days from the samples.



Graphic 1: BOD results after 14 days.

Discussion

The samples S1 and S3 have BOD/COD < 0.3, biodegradation will not proceed. S2 has BOD/COD > 0.6 and can be effectively treated biologically. Azaphilone has 0.3 < BOD/COD > 0.6, seeding is necessary to treat it biologically.

Conclusion

The wastewater of fermentation during xylindein production is not biodegradable, while after extraction the pigment is. The supernatant during the fermentation of azaphilone showed that the wastewater can be biodegradable. BOD_{14} is the recommended one.

(Xylindein: Naturally Produced Fungal Compound for Sustainable (Opto) Electronics, 2019)

(Chemical Profiling, Bioactivity Evaluation and the Discovery of a Novel Biopigment Produced by Penicillium purpurogenum CBS 113139, 2021)

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