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SUM2024
7th SYMPOSIUM ON CIRCULAR ECONOMY AND URBAN MINING

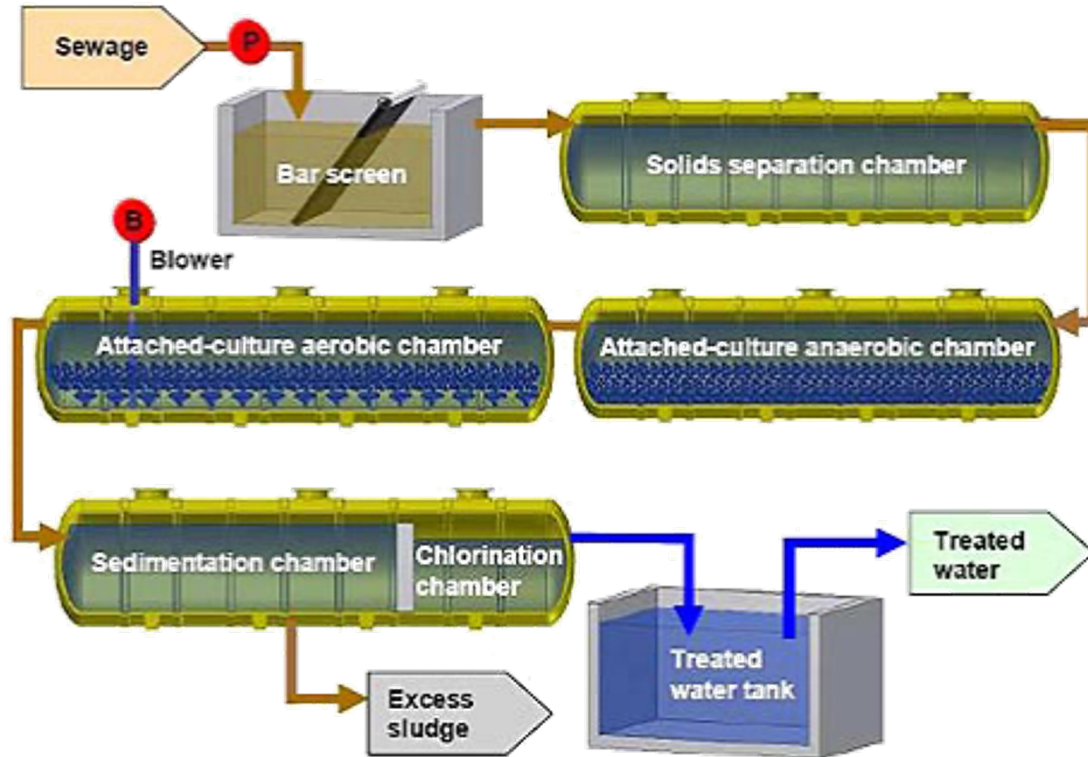
USE OF *GALDIERIA SULPHURARIA* (CYANIDIOPHYCEAE, RHODOPHYTA) FOR WASTEWATER PHYTODEPURATION

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Capri, 15-17 maggio 2024

INTRODUCTION

General Process Flow



- Conventional wastewater treatment plants (WWTs) focus on mechanically removing suspended solids and reducing biological oxygen demand through activated sludge.
- The capacity of conventional technologies to degrade pollutants is limited, particularly in the case of heavy metals, extremely high nutrient loads, and xenobiotics. This leads to an accumulation of these substances in groundwater.

INTRODUCTION

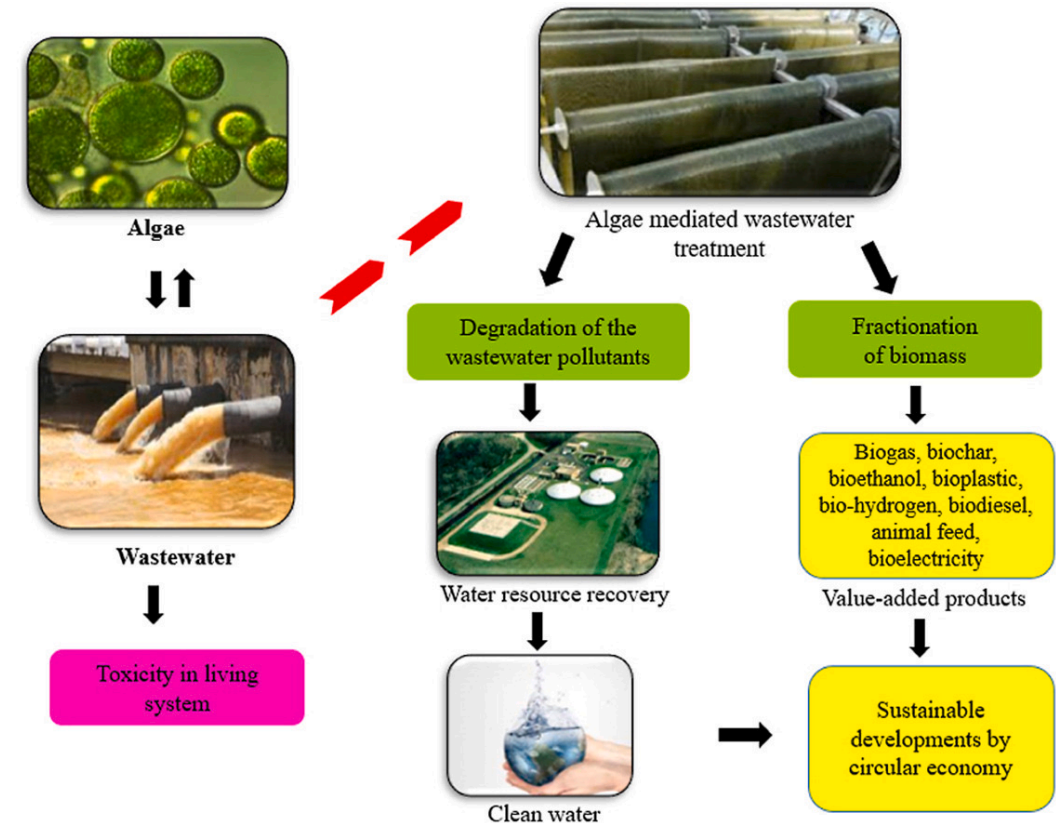
The use of microalgae in wastewater treatment (WWT) systems has two main objectives:

- (1) the direct adsorption or transformation of water contaminants
- (2) the improvement of the purification performance of bacterial systems

the provision of additional oxygen from photosynthesis

reducing the total energy costs of direct oxygen supply

indirect oxygen supply



***Galdieria sulphuraria*-ACUF427**

- It grows in volcanic soils with temperatures up to 50 °C and high concentrations of sulphur
- These microalgae are able to switch from photoautotrophic to mixo-heterotrophic growth
- It is highly flexible and can adapt to pH levels as low as 5.5, even though it naturally exists in conditions with a pH below 2
- this microalga can tolerate temperatures up to 56°C

Galdieria sulphuraria

Scientific classification

(not classified):	Archeplastida
Division:	Rhodophyta
Class:	Cyanidiophyceae
Order:	Cianidiali
Family:	Galdieriaceae
Genus:	Galdieria
Species:	<i>G. sulphuraria</i>

Binomial name

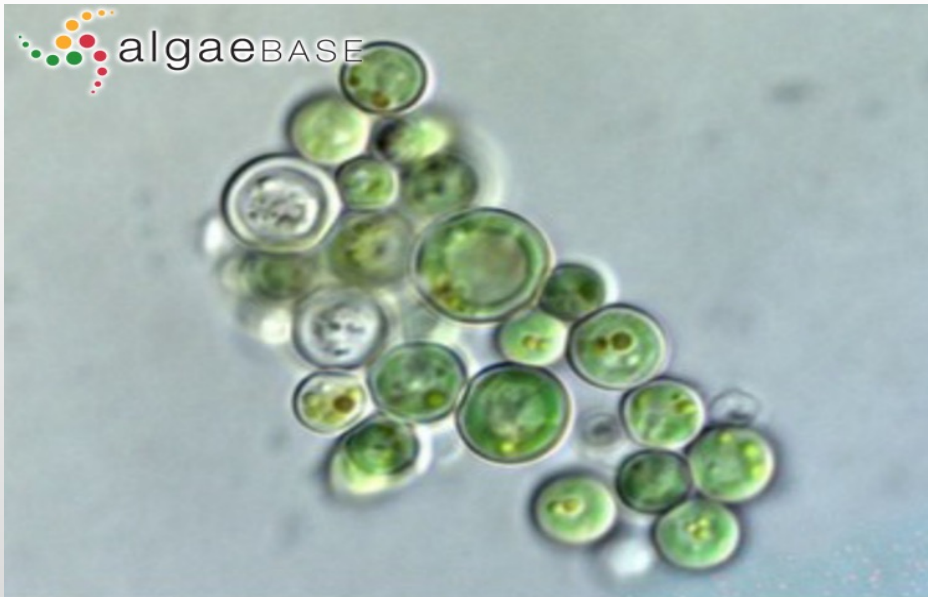
Galdieria sulphuraria

Merola et al., 1981



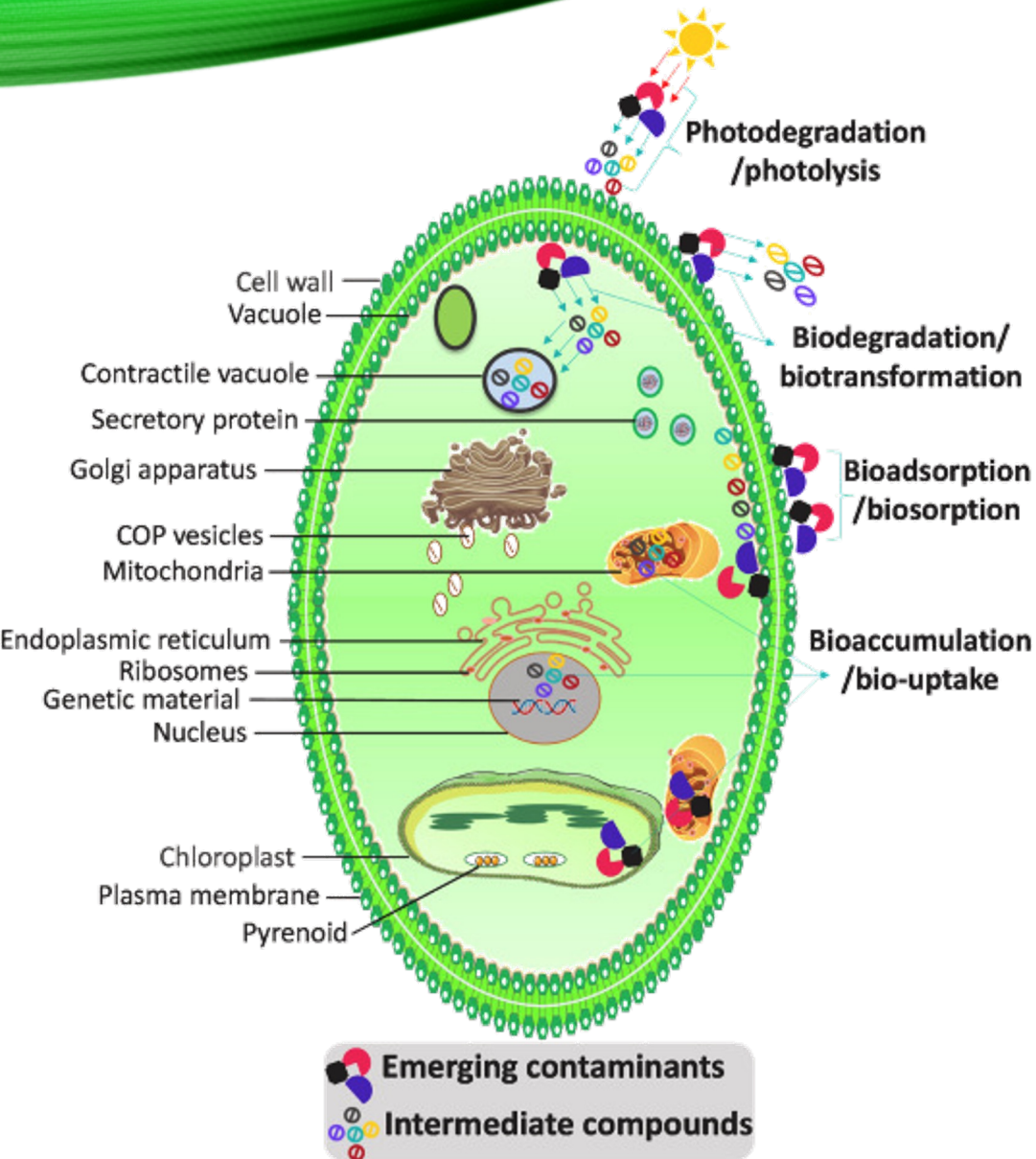
Galdieria sulphuraria-ACUF427

The efficacy of *Galdieria sulphuraria* in removing pollutants from wastewater has been evaluated in several studies in recent years:



- *Galdieria sulphuraria* can remove almost 100% of heavy metals from aqueous solutions, and bioabsorb precious metals even at very low concentrations.
- It can reduce the microbial load of various pathogens.
- It can operate a reduction in NH₄-N concentrations from 71.4% to 99.8% and almost complete removal of PO₄-P concentrations.

PHYTOREMEDIATION MECHANISMS



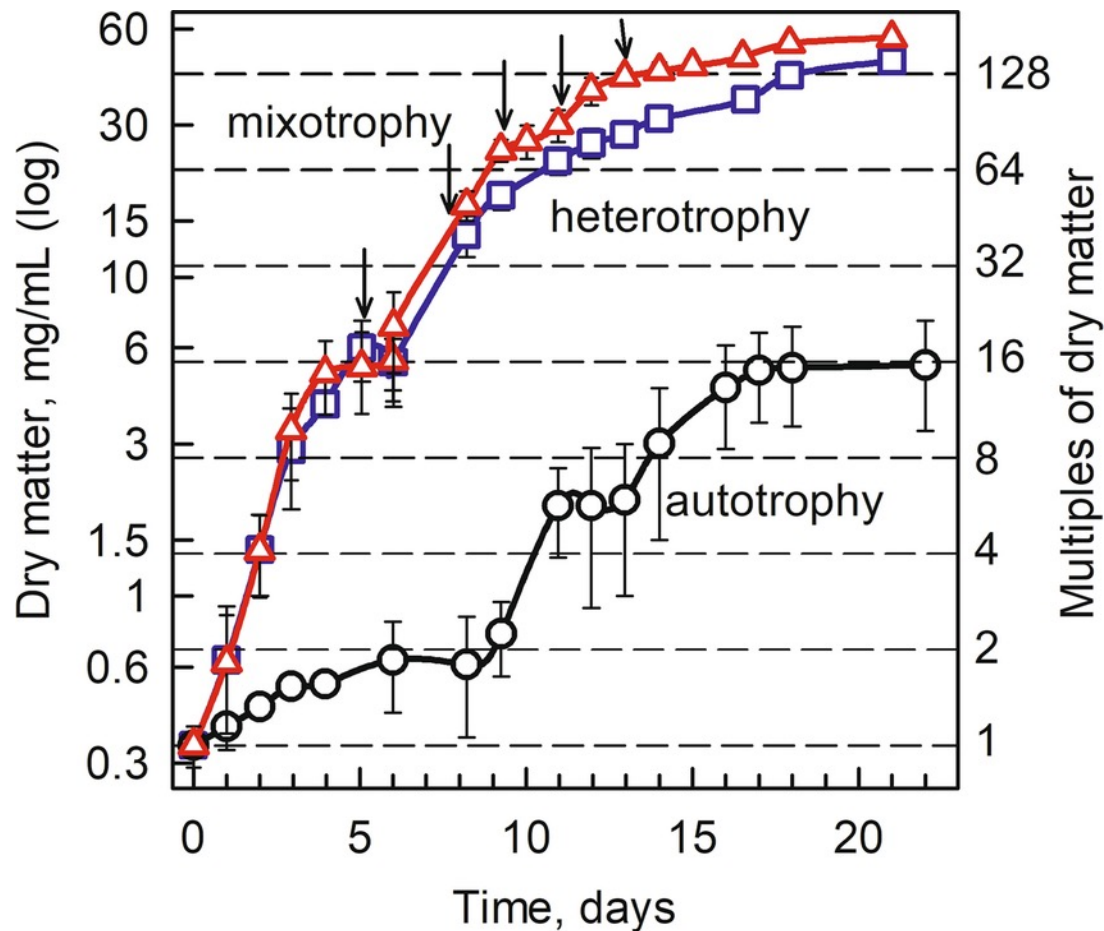
- *Galdieria sulphuraria* uses several mechanisms to phytoremediate wastewater, including bioabsorption, bioaccumulation and biodegradation.
- **Bioabsorption** is a passive process in which a biological material binds and concentrates contaminants in the water.
- *Galdieria* is used for waste detoxification by **Bioaccumulation**, where it absorbs substances and then accumulates or metabolizes them.
- **Biodegradation**, which involves the breakdown of complex compounds into simple and safe chemical elements. Basic biodegradation mechanisms can be divided into two categories: metabolic degradation, and cometabolism,

WATER TREATMENT APPLICATIONS

- *Galdieria sulphuraria* is considered an unrivaled microorganism candidate for various biotechnological applications in water treatment systems due to its unique extremophilic features.
- Potential applications of *Galdieria sulphuraria* in water treatment considering its characteristics:
 1. Enormous **metabolic versatility** in the utilization of carbon sources (including a large range of sugars and alcohols) for heterotrophic growth.
 2. Spherical **shape with thick-walled cells**
 3. Remarkable **acidophilic ability**.
 4. **High resistance** to high metal concentrations in aqueous solutions (even at low pH < 2.5)



WATER TREATMENT APPLICATIONS



- Algal systems are classified as photoautotrophic, heterotrophic or mixotrophic according to their metabolic carbon/energy choices.
- Mixotrophic systems have the potential to meet their carbon and energy needs from either organic or inorganic chemicals.

CHALLENGES

Despite its potential in phytodepuration, the use of *Galdieria sulphuraria* poses some challenges that need to be addressed in order to optimise the effectiveness and scalability of this technology:

1 Optimising growth conditions

The growth and bioremediation effectiveness of *Galdieria sulphuraria* can be influenced by factors such as temperature, light, pH and nutrient concentration. It is important to optimise these conditions for best results.

2 Scalability

Scalability of *Galdieria sulphuraria* phytodepuration to large wastewater treatment plants



CONCLUSIONS

- ***Galdieira sulphuraria*** has been shown to be a promising alga for the removal of various pollutants from wastewater and has several advantages over other methods of wastewater treatment
- It represents a potential and viable alternative to traditional wastewater treatment due to its lower operational and energy costs, as well as the ability to harvest a resource such as biomass
- The ability to use CO₂ emitted by other industrial plants for microalgae cultivation, thereby reducing atmospheric emissions, is an advantage of this approach.

Thanks!



MINISTERO DELLA
TRANSIZIONE ECOLOGICA

We thank the Italian Ministry of Ecological Transition (MITE) for providing financial support (PHYcoREcycling- PHYRE", D.D. n.84 09/12/2021, E.C. 85 07/09/2023.