Workshop “UniBS racconta la ricerca”

Fiera FUTURA, Brescia, 3 ottobre 2022

Soluzioni innovative per il recupero e la valorizzazione degli scarti agricoli nelle operazioni di risanamento ambientale:

i progetti CREIAMO e RICREA

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FUTURA EXPO
ECONOMIA X L'AMBIENTE 2·3·4 OTTOBRE 2022

UNIVERSITÀ DEGLI STUDI DI BRESCIA

Economia circolare

- L'**economia circolare** è un modello economico pensato per ottimizzare l'uso delle risorse naturali, riducendo la produzione di rifiuti e prevedendo il loro riutilizzo in altre filiere produttive
- Implica condivisione, prestito, riutilizzo, riparazione, ricondizionamento e riciclo dei materiali e prodotti esistenti il più a lungo possibile
- E' **alternativo** al tradizionale modello **economico lineare** 'take-make-dispose' si basa sull'accessibilità di grandi quantità di risorse ed energia

(https://www.europarl.europa.eu/)

L’agricoltura in Italia e Lombardia

- Nel 2020 il **valore aggiunto** dell’agricoltura è stato di **31,3 miliardi** di euro. L’Italia è risultata **prima in Europa** seguita da Francia (30,2) e Spagna (29,3)
- La **Lombardia** si conferma da diversi anni, la **prima regione agricola d’Italia**
  - **69% del territorio** dedicato all’agricoltura
  - **50.000 aziende agricole**
  - **37% del latte italiano**
  - **42% del riso italiano**
  - **40% dei prodotti suinicoli italiani**
  - **34 prodotti DOP e IGP** sui 274 italiani
  - **42 vini a marchio di qualità** (5 DOCG, 22 DOC e 15 IGT). Più dell’80 % della superficie coltivata a vite in Lombardia è dedicata a produzioni di qualità

(fonti: ISTAT, 2021; Regione Lombardia, 2020)

Il progetto CREIAMO

CREIAMO

Economia circolare delle filiere olivicola e vitivinicola. Valorizzazione dei sottoprodotti e degli scarti tramite processi innovativi e nuovi modelli di business

UNIVERSITY OF BRESCIA

UNIVERSITA' DEGLI STUDI DI MILANO BICOCCA

ENEA

Funded by

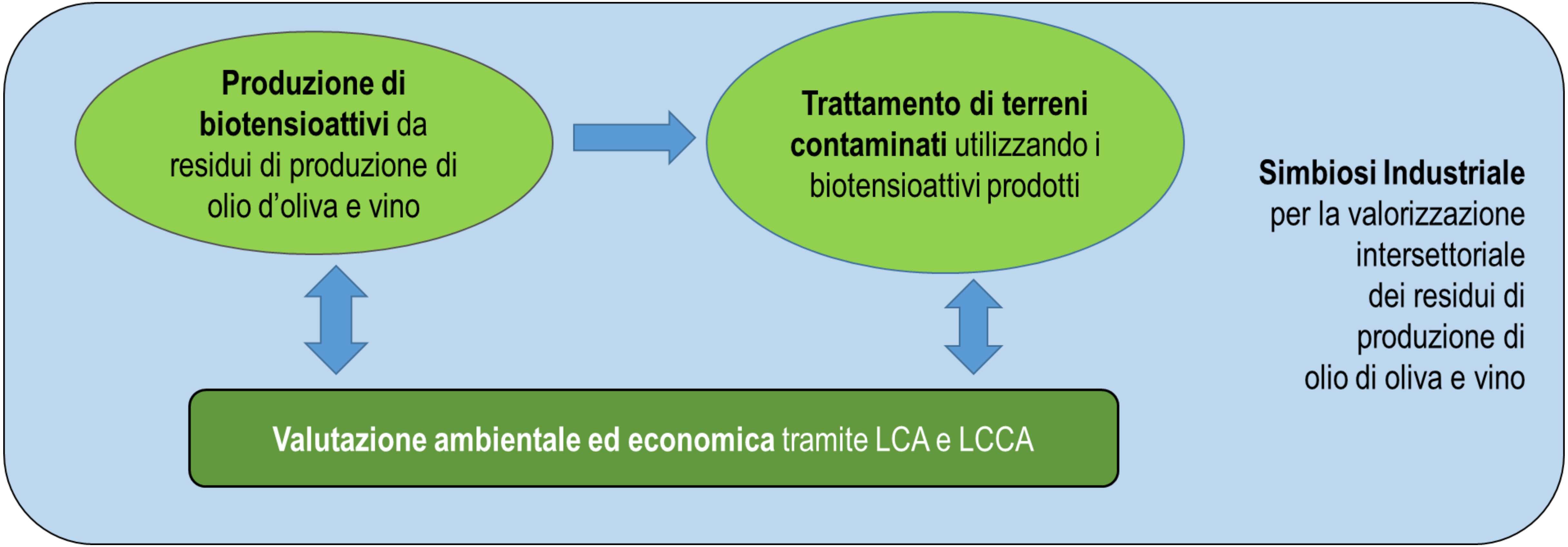
Fondazione CARIPLO

Bando 2018 "Economia circolare: ricerca per un futuro sostenibile"

Durata: 30 mesi

Inizio: luglio 2019

Il progetto CREIAMO



Siti contaminati in Italia

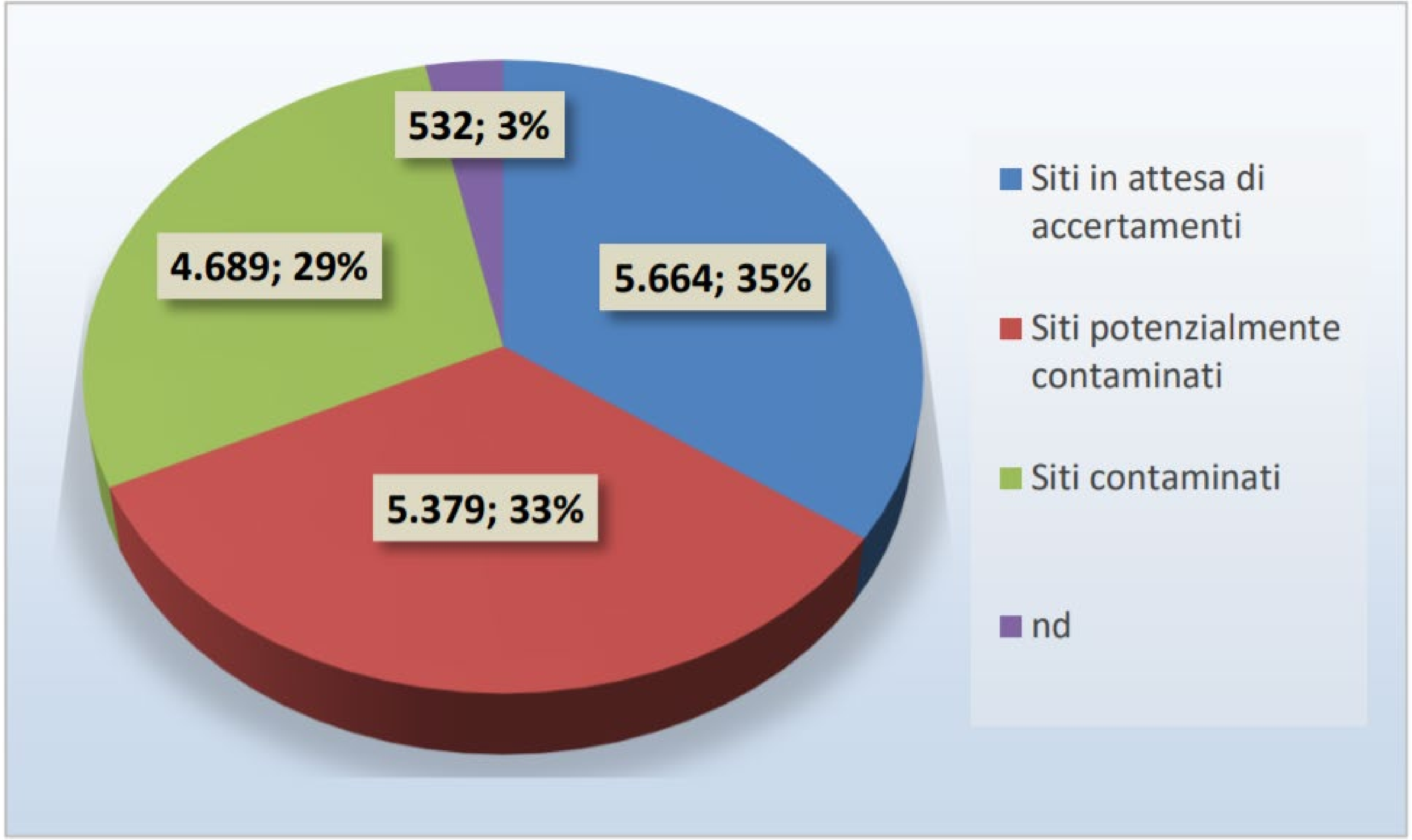


Figura 4.8 *Distribuzione dello stato della contaminazione peri procedimenti in corso*

(fonte: SNPA, 2021)

Caratterizzazione di vinacce e sansa

	Nonfermented grape marc (NF)	Fermented grape marc (F)	Wine lees (WL)
pH	4.01	3.6	5.9
Protein (g/kg)	39	34	47
at 100-105 °C (%)	62.53%	74.52	66.54
C/N ratio	30.6	25.1	24.5
ASH (%)	4.94	8.18	5.31
Alcoholic grade (ml/100 g)	0.7	7.3	0.2
Total polyphenol content (TPC) (g/kg)	6.7	6.8	6.3
Malic acid (g/kg)	4.4	1.9	n.q (<0.1 g/kg)
Lactic acid (g/kg)	n.q (<0.1)	n.q (<0.1 g/kg)	n.q (<0.1 g/kg)
Tartaric acid (g/kg)	14.0	22.3	0.8
Acetic acid (g/kg)	1.23	0.71	0.79
Glycerin (g/kg)	4.39	5.35	0.35
Arabinose (g/kg)	n.q (<0.1)	0.3	n.q (<0.1 g/kg)
Fructose (g/kg)	61.3	0.2	0.3
Galactose (g/kg)	0.1	n.q (<0.1 g/kg)	n.q (<0.1 g/kg)
Glucose (g/kg)	65.4	0.4 g/kg	0.3
Mannose (g/kg)	n.q (<0.1 g/kg)	n.q (<0.1 g/kg)	n.q (<0.1 g/kg)
Rhamnose (g/kg)	n.q (<0.1 g/kg)	n.q (<0.1 g/kg)	n.q (<0.1 g/kg)
Ribose (g/kg)	n.q (<0.1 g/kg)	n.q (<0.1 g/kg)	n.q (<0.1 g/kg)
Saccharose (g/kg)	n.q (<0.1 g/kg)	n.q (<0.1 g/kg)	n.q (<0.1 g/kg)
Trehalose (g/kg)	n.q (<0.1 g/kg)	n.q (<0.1 g/kg)	n.q (<0.1 g/kg)
Xylose (g/kg)	n.q (<0.1 g/kg)	n.q (<0.1 g/kg)	n.q (<0.1 g/kg)

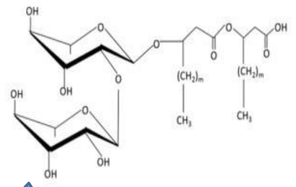
	Olive oil pomace (OMP)
pH	4.95
Total nitrogen (%)	0.93 %
At 100-105 °C	56.94%
Total acidity	5.0 g/kg
Ash (%)	2.79%
Calcium (mg/kg)	1025
Phosphorous (mg/kg)	340
Magnesium (	158
Potassium (mg/kg)	4615
Total polyphenolic (g/kg)	1.1
Glycerin (g/kg)	0.82
Fructose (g/kg)	n.q (<0.1 g/kg)
Glucose (g/kg)	0.2
Arabinose (g/kg)	n.q (<0.1 g/kg)
Galactose (g/kg)	0.2
Mannose (g/kg)	n.q (<0.1 g/kg)
Ramnose (g/kg)	n.q (<0.1 g/kg)
Ribose (g/kg)	n.q (<0.1 g/kg)
Saccharose (g/kg)	n.q (<0.1 g/kg)
Trealose (g/kg)	n.q (<0.1 g/kg)
Xylose (g/kg)	n.q (<0.1 g/kg)

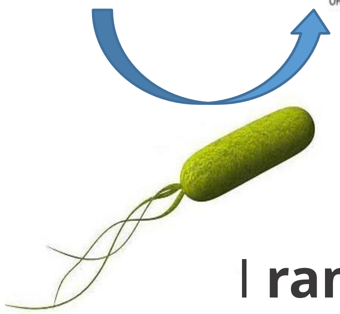
Produzione di ramnolipidi

Pathogenic

***Pseudomonas aeruginosa* PAO1**

Prd. RhaRha-C10C10
(Abdel-Mawgoud et al. 2010)





Non pathogenic

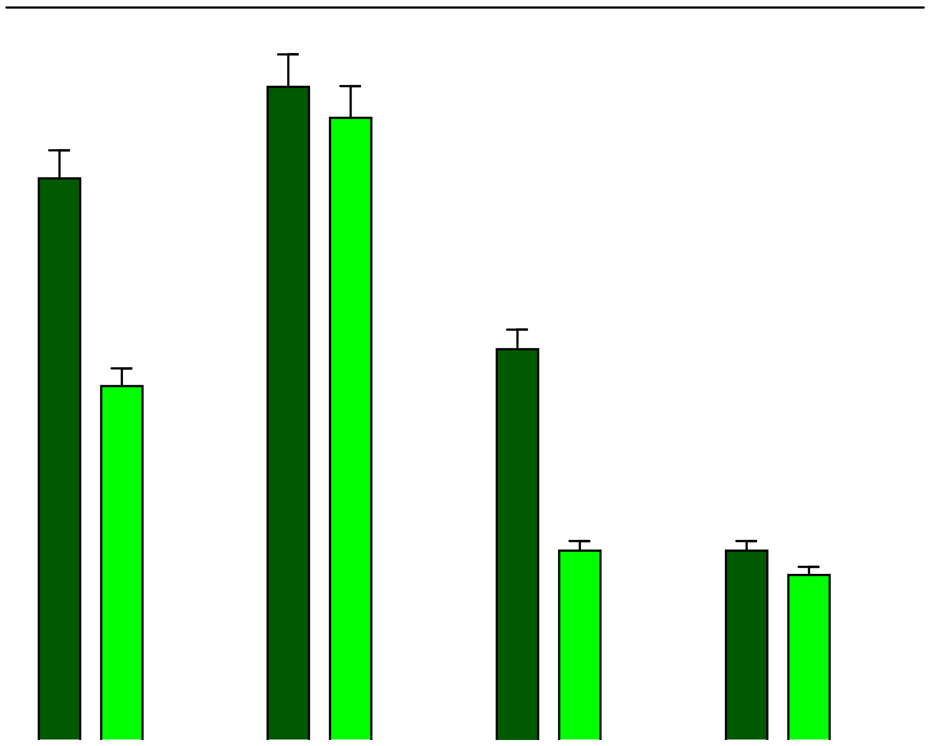
***Pseudomonas chlororaphis* DSM 50083**
(Gunther et al. 2005) Prd. Rha-C10C10

***Burkholderia thailandensis* E264**
(Dubeau et al. 2009; Funston et al. 2016) Prd. RhaRha-C14C14

***Paraburkholderia kururiensis* KP23^{T}**
(Tavares et al. 2013)

I **ramnolipidi** hanno una **elevata capacità desorbente**; presentano un gruppo polare glicosidico (ramnosio) e una coda lipofila costituita da una o più catene di acidi grassi (ad es., l’acido 3-idrossidecanoico)

Produzione di ramnolipidi

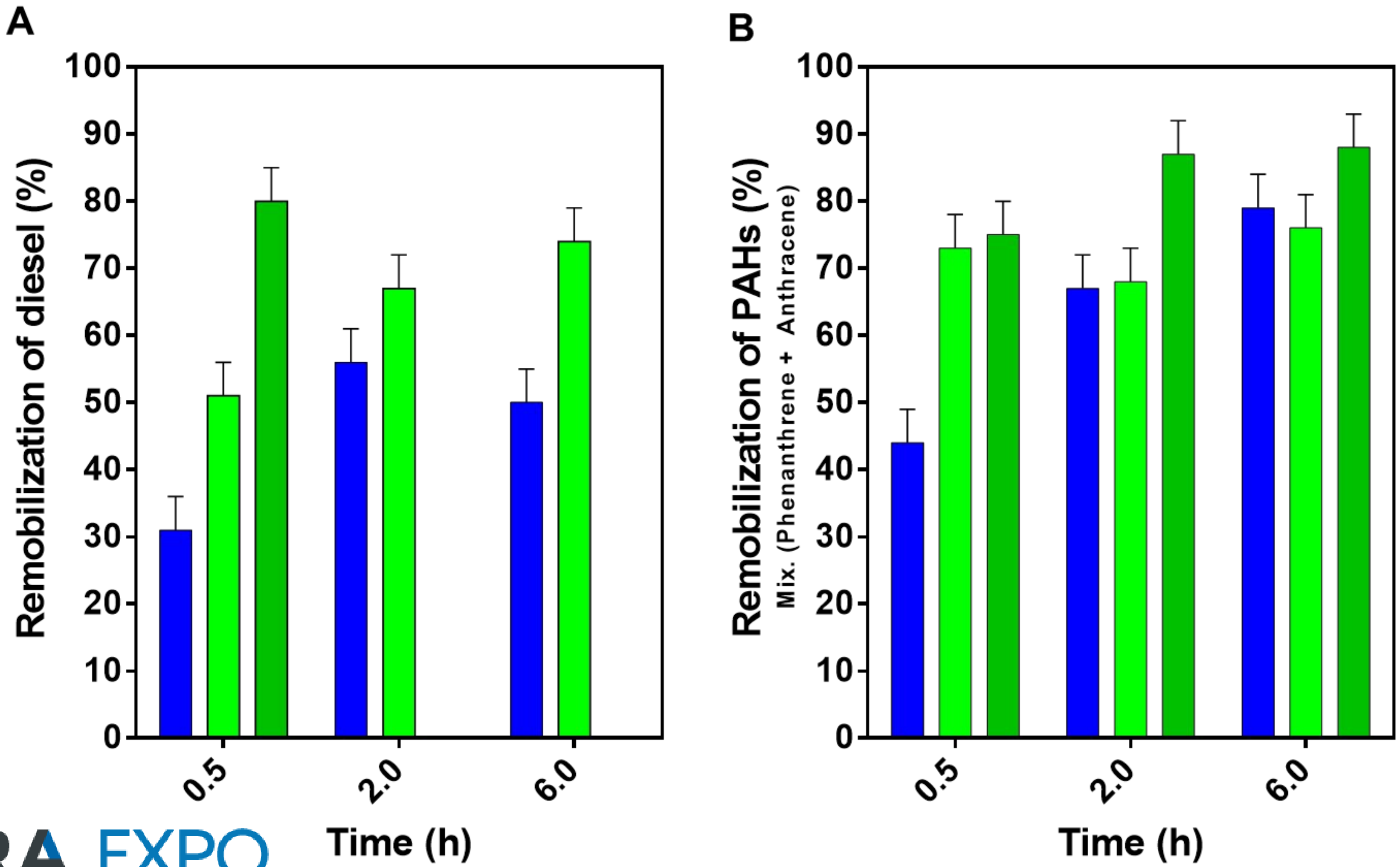


Confronto con la letteratura scientifica

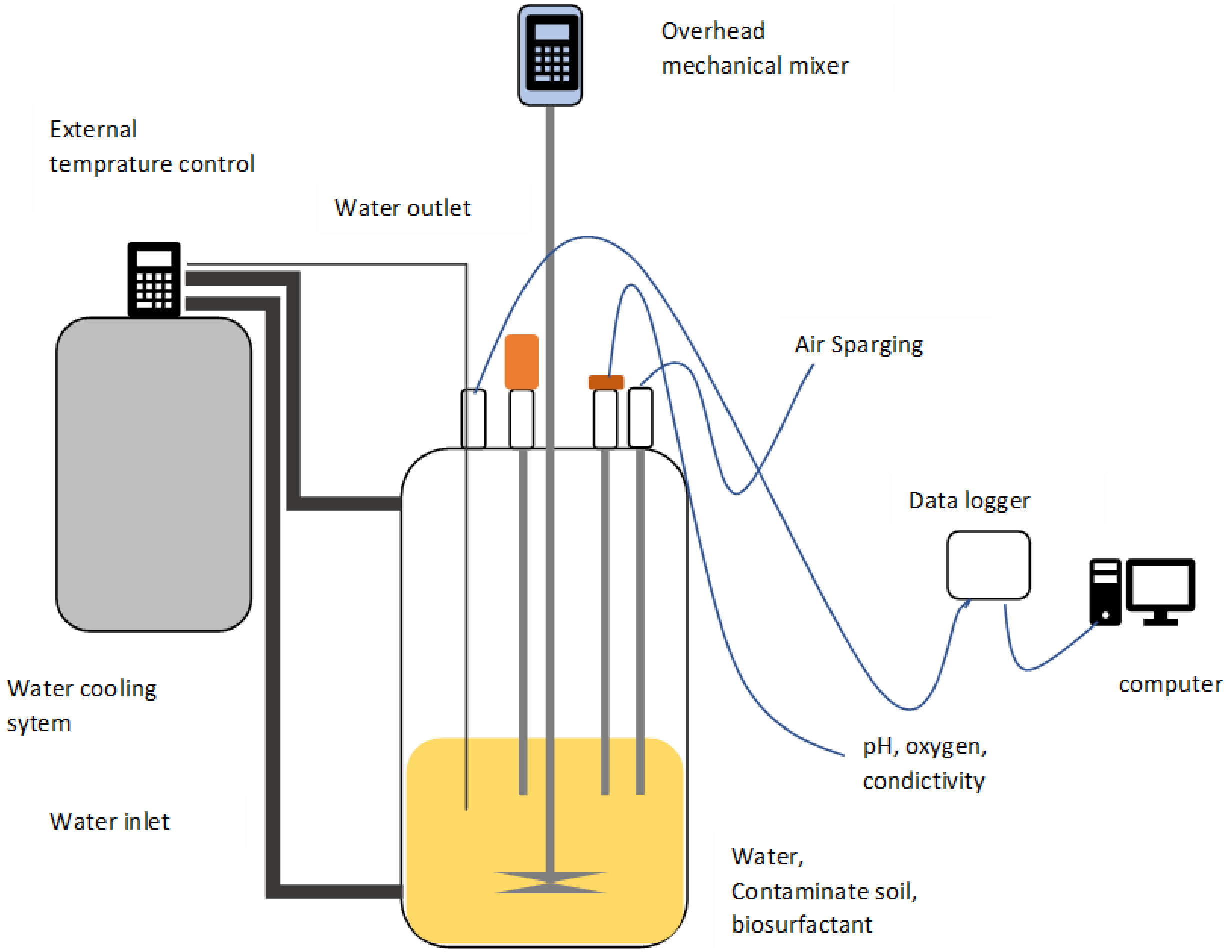
Substrate(s)	Pretreatments	Strain	Biosurfactant type	Biosurfactant production (mg/L)	References
Winery wastes					
Trimming wine shoots	Acid hydrolysis + detoxification	*Lactobacillus pentosus* CECT-4023^T	Bioemulsifier	6500	(Moldes et al. 2007)
Trimming wine shoots	Acid hydrolysis + detoxification	*Lactobacillus acidophilus* CECT-4179 and *Debaryomyces hansenii* Y-7426	Not characterized	NA	(Portilla et al. 2008)
Grape marcs	Acid hydrolysis	*Lactobacillus pentosus* CECT-4023^T	Bioemulsifier	4.8	(Portilla-Rivera et al. 2008)
Trimming wine shoots + wine lees	Acid hydrolysis + enzymatic hydrolysis (shoots) Recovery of tartaric acid (lees)	*Lactococcus lactis* ssp. lactis CECT-4434	Not characterized	1.5	(Rodríguez et al. 2010)
Wine lees	NO	*Lactococcus lactis* ssp. lactis CECT-4434	Glycolipopeptide	6.64	(Vera et al. 2018)
Grape marcs (nonfermented) (white)	**Raw broth 80% (v/v)**	***Burkholderia thailandensis* E264**	**Safe long-chain rhamnolipids**	**1070**	**Our study**
Olive oil wastes					
Olive oil Mill effluent (OOME)	Dilution + $NaNO_3$	*Pseudomonas* sp.JAMM	Rhamnolipid	1400 >	(Mercadé et al. 1993)
Olive mill waste (OMW)	NO	*B. subtili* N1 and *P. aeruginosa* PAO1	Surfactin and Rhamnolipid	3.12 (Surfactin) 191.46 (Rhamnolipid)	(Moya-Ramírez et al. 2015)
Olive mill waste (OMW)	i) acid hydrolysis ii) enzymatic hydrolysis iii) acid hydrolysis + enzymatic hydrolysis	*B. subtilis* N1 and *P. aeruginosa* PAO1	Surfactin and Rhamnolipid	26.5 (Surfactin) 299 (Rhamnolipid)	(Moya Ramírez et al. 2016)
Olive mill waste (OMW)	NO	*P. aeruginosa* #112	Rhamnolipid	5100	(Gudiña et al. 2016)
Olive mill pomace(OMP)	**Autoclaved in the culture medium 2% (w/v)**	***Burkholderia thailandensis* E264**	**Safe long-chain rhamnolipids**	**300**	**Our study**

Soil washing tests

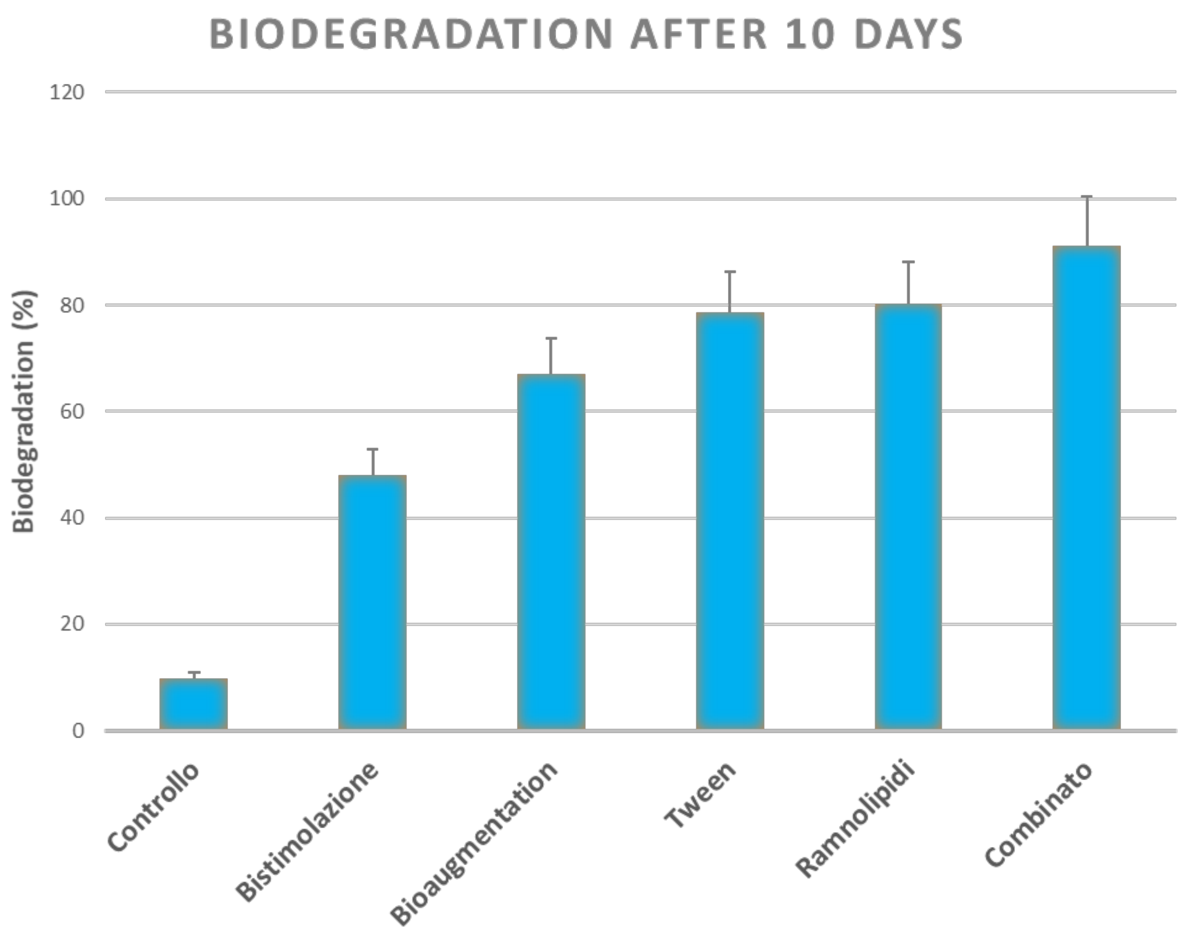
A: real contaminated soil by diesel (>6000 ppm)   B: PAH- artificially contaminated soil (4000 ppm)

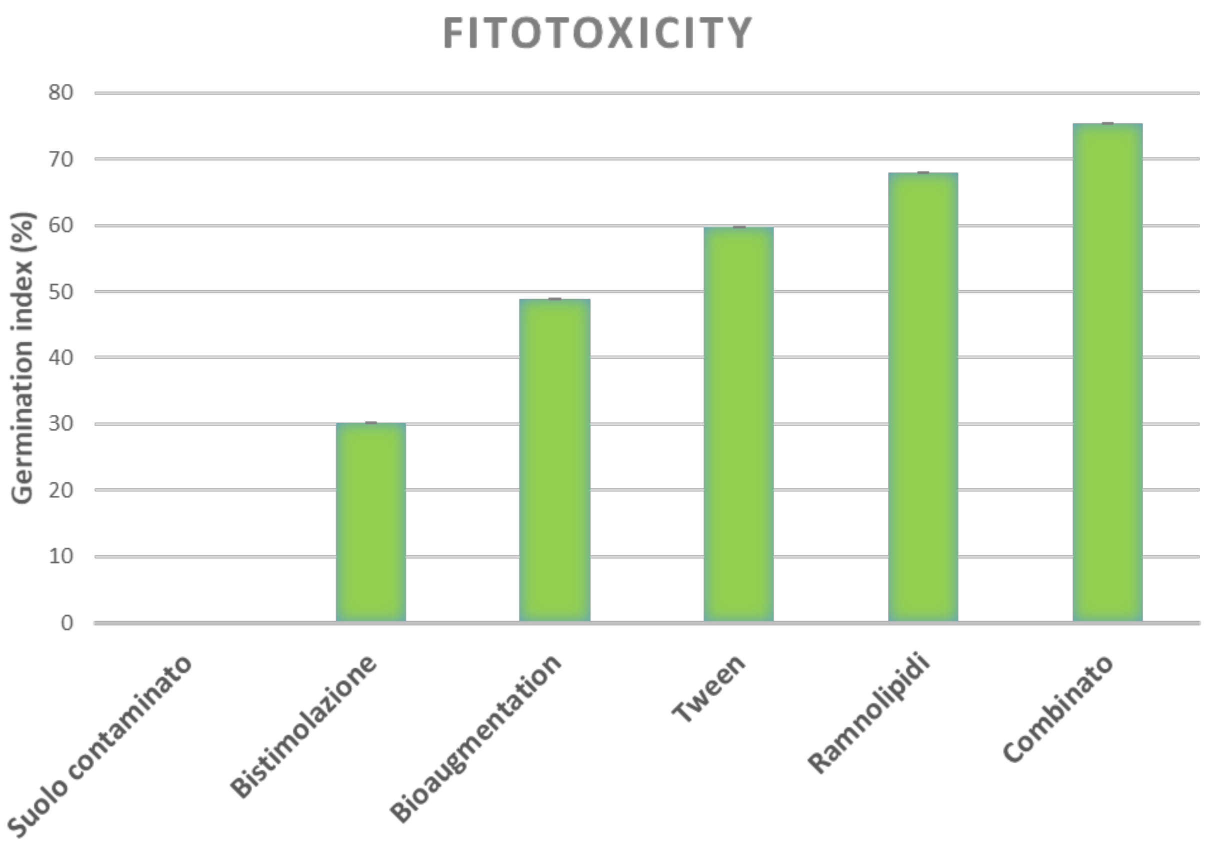


Bioslurry tests



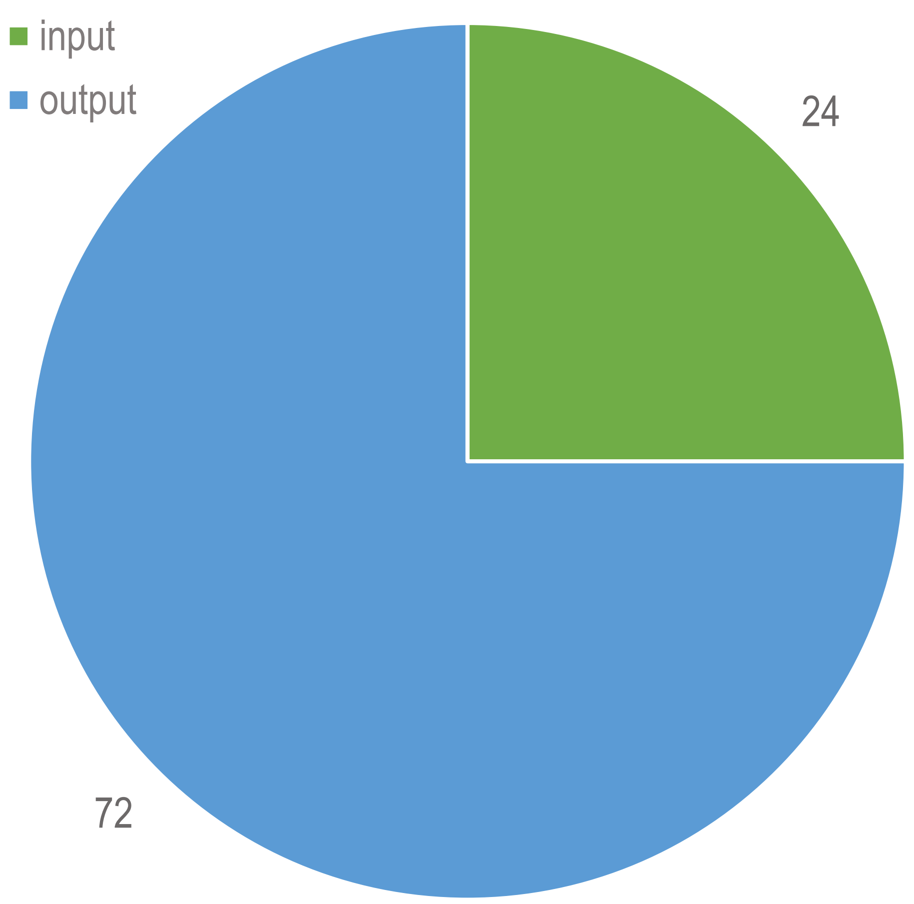
Bioslurry tests

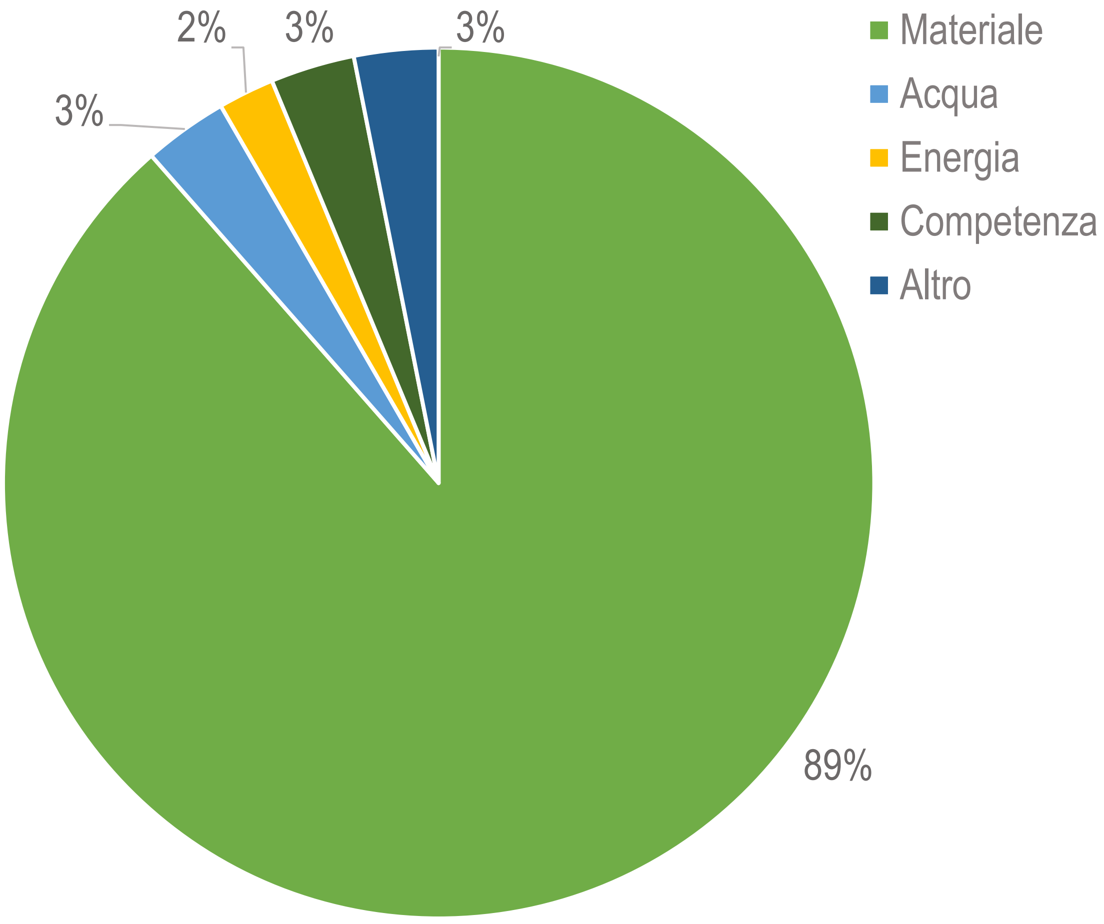




Tavolo di lavoro di simbiosi industriale

Durante l'evento sono state condivise **96 risorse**





Recenti pubblicazioni

Waste and Biomass Valorization (2021) 12:4733–4743
https://doi.org/10.1007/s12649-020-01315-8

SHORT COMMUNICATION

Potentials of Winery and Olive Oil Residues for the Production of Rhamnolipids and Other Biosurfactants: A Step Towards Achieving a Circular Economy Model

Alif Chebbi[2] · Andrea Franzetti[2] · Francine Duarte Castro[1] · Franco Hernan Gomez Tovar[1] · Massimiliano Tazzari[2] · Silvia Sbaffoni[3] · Mentore Vaccari[1]

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Abstract
Vineyard and olive farming are deeply rooted in the economy, culture, and even the welfare of Mediterranean countries. Although numerous approaches and methods were developed to valorize their agricultural residues, several challenges remain to overcome moving towards the Circular Economy (CE). Conventional treatments of winery and olive mill wastes are becoming increasingly expensive, demanding significant amounts of effort, resources, and energy for safe waste discharge. Therefore, the need to recycle, reuse, and recover energy and valuable biocompounds from the wastes of these two sectors become apparent. In the context of increasing waste production, climate change, coupled with dramatic rises in demand from a much larger global population and customers, CE offers the prospect of a better f
diverse biosurfactants (BS) containing both hydrophilic and hydrophobic moieties that
surface and interfacial tensions, form micelles, and emulsify immiscible substances. Amc
are glycolipids produced by some gram-negative bacteria with various potential applic
bioremediation of contaminated soils. In contrast to several biosurfactants, this particul
economically competitive biomolecules with its synthetic equivalents. For that, we higl
challenges, and the future aspects towards the production of this particular type of gly
wastes. Therefore, we proposed the critical points that should be assumed through the pa
nolipid production using these two potential agricultural residues. This review might h
to find novel CE models.

Contents lists available at ScienceDirect
Chemosphere
journal homepage: www.elsevier.com/locate/chemosphere

Remediation of soil polluted with petroleum hydrocarbons and its reuse for agriculture: Recent progress, challenges, and perspectives

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HIGHLIGHTS

- PHs pollution can deteriorate soil properties and adversely affect the environment, humans, and other organisms' health.
- Various emerging remediation technologies, internal and external factors that affect the soil restoring process are reviewed.
- Nanotechnology looks very effective for remediation, but its success depends on

GRAPHICAL ABSTRACT

ABSTRACT

Petroleum hydrocarbons (PHs) are used as raw materials in many industries and primary energy sources. However, excessive PHs act as soil pollutants, posing serious threats to living organisms. Various *ex-situ* or *in-situ* chemical and biological methods are applied to restore polluted soil. However, most of the chemical treatment methods are expensive, environmentally unfriendly, and sometimes inefficient. That attracts scientists and researchers to develop and select new strategies to remediate polluted soil through risk-based analysis and eco-friendly manner. This review discusses the sources of PHs, properties, distribution, transport, and fate in the environment, internal and external factors affecting the soil remediation and restoration process, and its effective

Applied Microbiology and Biotechnology (2021) 105:3825–3842
https://doi.org/10.1007/s00253-021-11292-0

ENVIRONMENTAL BIOTECHNOLOGY

Burkholderia thailandensis E264 as a promising safe rhamnolipids' producer towards a sustainable valorization of grape marcs and olive mill pomace

Alif Chebbi[1] · Massimiliano Tazzari[1] · Cristiana Rizzi[1] · Franco Hernan Gomez Tovar[2] · Sara Villa[1] · Silvia Sbaffoni[3] · Mentore Vaccari[2] · Andrea Franzetti[1]

Received: 5 January 2021 / Revised: 30 March 2021 / Accepted: 12 April 2021 / Published online: 20 April 2021

Abstract
Within the circular economy framework, our study aims to assess the rhamnolipid production from winery and olive oil residues as low-cost carbon sources by nonpathogenic strains. After evaluating various agricultural residues from those two sectors, *Burkholderia thailandensis* E264 was found to use the raw soluble fraction of nonfermented (white) grape marcs (NF), as the sole carbon and energy source, and simultaneously, reducing the surface tension to around 35 mN/m. Interestingly, this strain showed a rhamnolipid production up to 1070 mg/L (13.37 mg/g of NF), with a higher purity, on those grape marcs, predominately Rha-Rha C_{14}-C_{14}, in MSM medium. On olive oil residues, the rhamnolipid yield of using olive mill pomace (OMP) at 2% (w/v) was around 300 mg/L (15 mg/g of OMP) with a similar CMC of 500 mg/L. To the best of our knowledge, our study indicated for the first time that a nonpathogenic bacterium is able to produce long-chain rhamnolipids in MSM medium supplemented with winery residues, as sole carbon and energy source.

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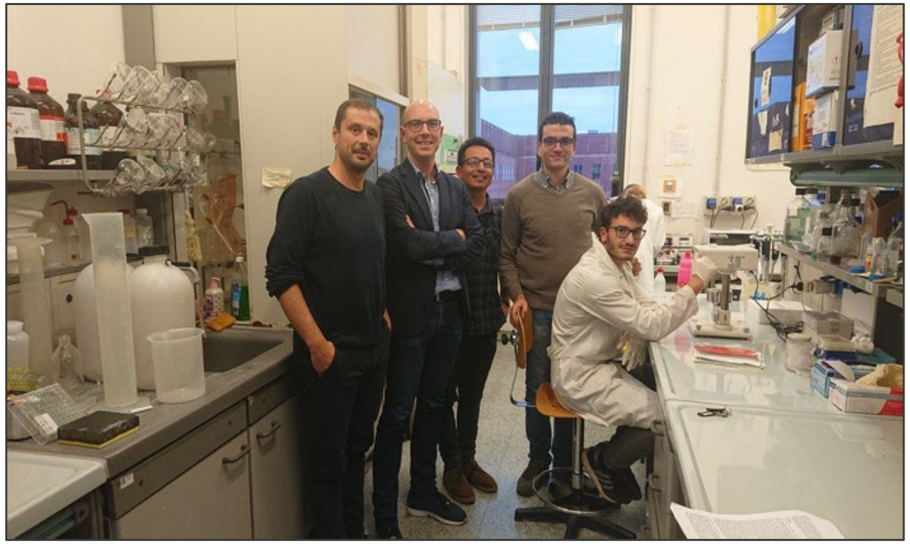
Ricercatori coinvolti



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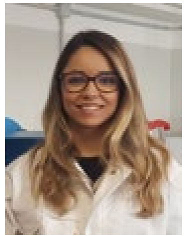

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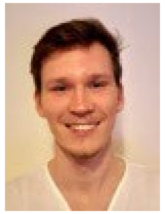

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Il progetto Ricrea - Rifiuti cerealicoli per il biorisanamento

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BioCheM SOLUTIONS

CONFCOOPERATIVE LOMBARDIA

QUADRIFOGLIO soc. coop. agricola

SISTEMI AMBIENTALI

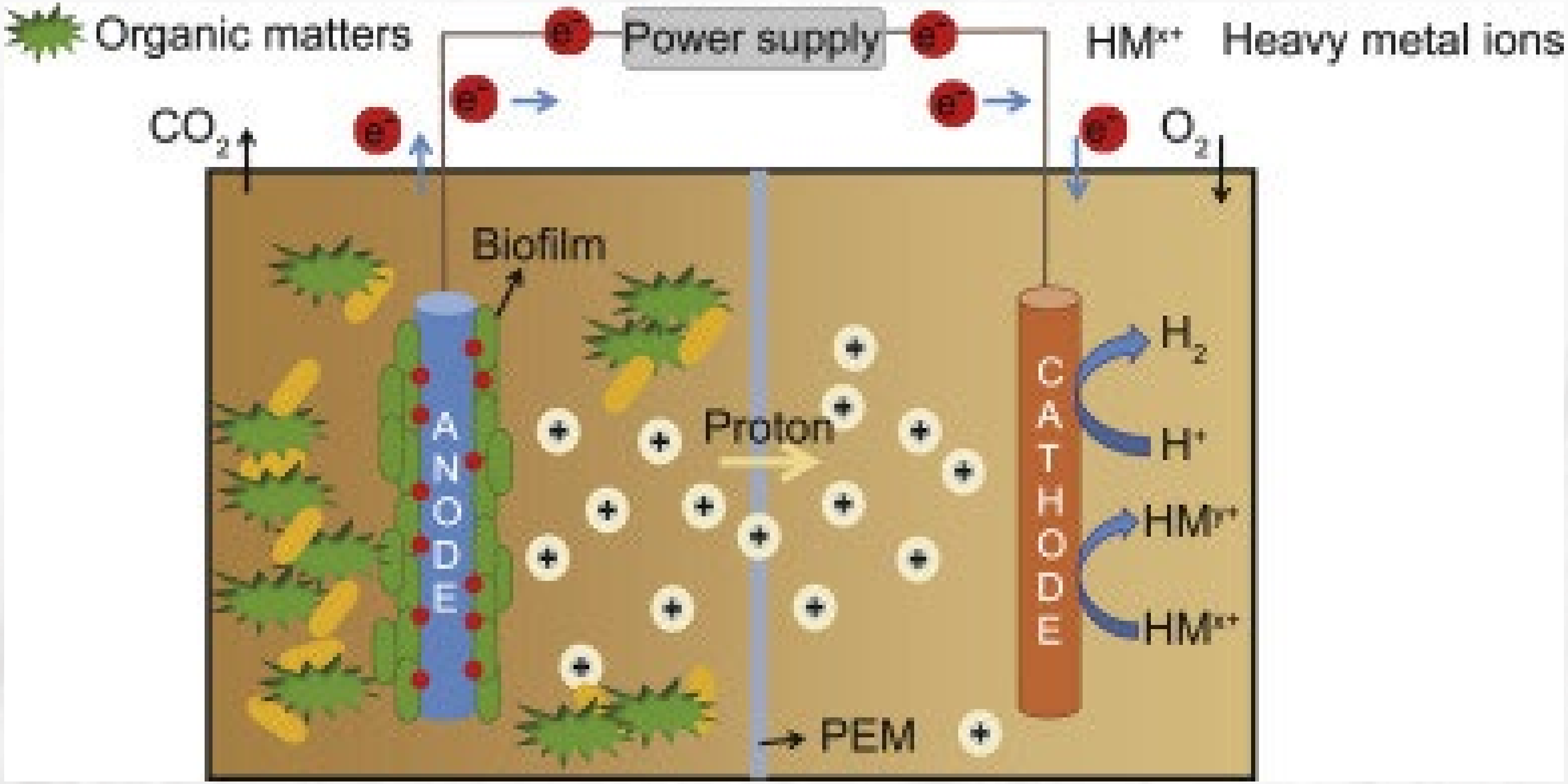
Progetto cofinanziato da:

MINISTERO DELLA TRANSIZIONE ECOLOGICA

Durata: 24 mesi

Inizio: marzo 2022

Il processo bioelettrochimico



Grazie per l'attenzione!

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