Newsletter

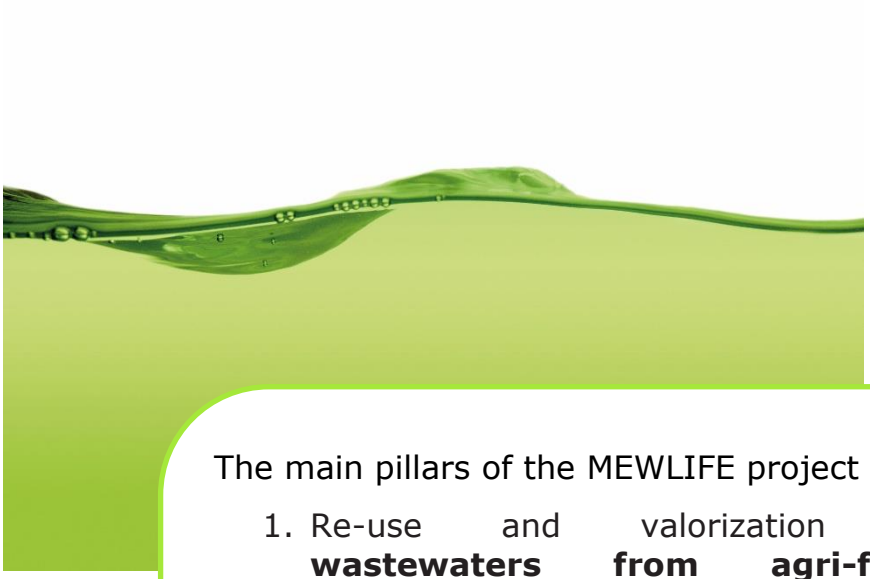
Issue #3 – September 2020

MEWLIFE

MicroalgaE biomass from phototrophic-heterotrophic cultivation using olive oil Wastewaters

PROJECT SUMMARY

MEWLIFE is a 3-years LIFE project aiming to demonstrate the environmental benefit and economic feasibility of an innovative approach to produce microalgal biomass in an integrated phototrophic-heterotrophic cultivation system using preconcentrated (in a membrane filtration plant) olive oil wastewaters as carbon source for growing algae, thus contributing to waste reuse and valorization.

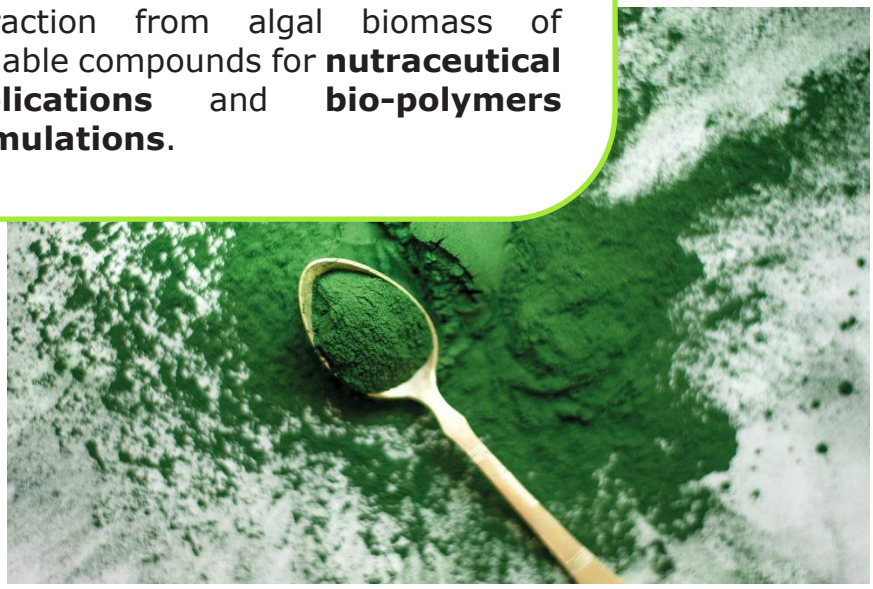


The main pillars of the MEWLIFE project are:

1. Re-use and valorization of **wastewaters from agri-food industry** as input for algae cultivation.

2. Costs reduction in **microalgae cultivation** step due to the integrated phototrophic-heterotrophic system.

3. Extraction from algal biomass of valuable compounds for **nutraceutical applications** and **bio-polymers formulations**.



Check out the **MEWLIFE** brochure and video

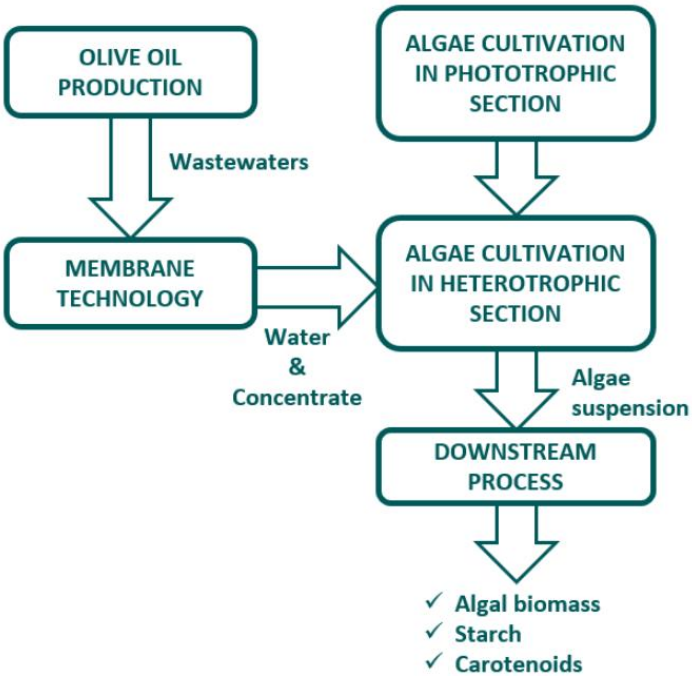
INSIDE*MEWLIFE*

Olive oil wastewaters

Europe produces about 70% of the global olive oil (Spain, Italy and Greece as main producers). Wastewaters from olive oil production plants cannot be treated in conventional biological depuration plants due to the toxic effect of antioxidants (polyphenols) on active sludge.
As results, these wastewaters are discharged in the environment acting as anti-microbial and phytotoxic agents.
The 3-years MEWLIFE project aims to overcome these hurdles with the development and validation on pilot scale of an integrated set of technologies for olive oil wastewaters remediation based on both physical and biological treatments.

Microalgal biomass

Microalgae are a promising feedstock for the sustainable supply of commodities and specialties for food and non-food products. Despite this potential, implementation to date is limited, mainly due to unfavorable economics. Major bottleneck is the lack of available biomass at acceptable costs. In the MEWLIFE project a new integrated microalgal cultivation strategy has been developed, reducing costs associated with the cultivation system and using the organic carbon content of olive oil wastewaters to enhance microalgal biomass growth.

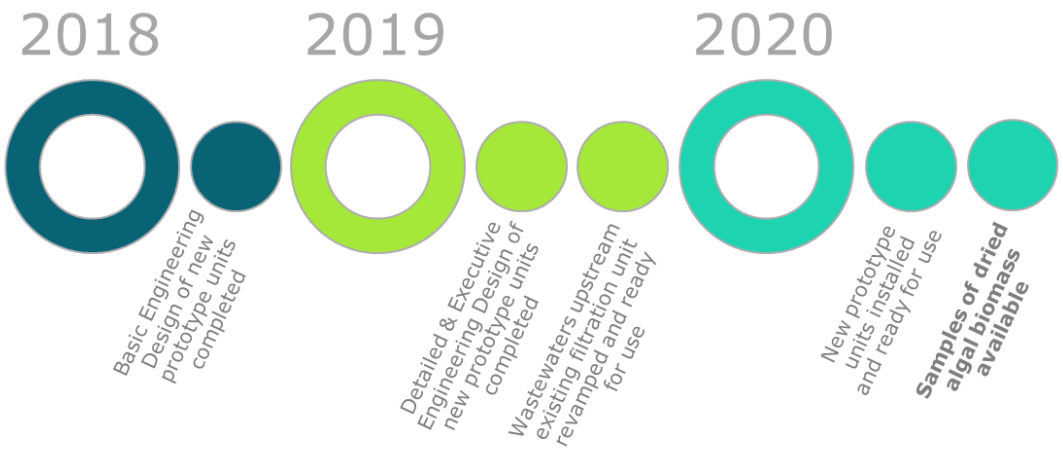


Extraction of high-added value products

The microalgal biomass produced in the MEWLIFE project will be tested for application in nutraceuticals (by extracting the lipid fraction and carotenoids: astaxanthin, lutein and beta-carotene) and for bio-polymer production (by extracting starch and other carbohydrates).

See insight on following pages.

MEWLIFE *WHERE WE ARE*



Operation of the OMWW pre-treatment membrane prototype: Ultra-Filtration & Nano-Filtration

OLIVE MILL WASTEWATERS (OMWW) PRE-TREATMENT IN THE REVAMPED AND OPERATING **MEMBRANE PROTOTYPE** AT LABOR SITE IN ROME

Collection of concentrate (UF+NF)

Collection of permeate (UF+NF)

MEWLIFE *WHERE WE ARE*

Microalgae cultivation

Microalgae cultivation has been started in photobioreactors as first step (left picture). Then, microalgal inoculum has been transferred in fermenters for bulk cultivation (right picture).

ALGAE CULTIVATION SECTION
INSTALLED AND OPERATING AT NEXTCHEM SITE IN ROME

OMWW fractions

Olive mill wastewaters (OMWW) concentrate and permeate have been transferred from LABOR to NEXTCHEM/BIOP site and stored in outside vessels ready for use in the cultivation plant.

Dewatering steps and final dried product

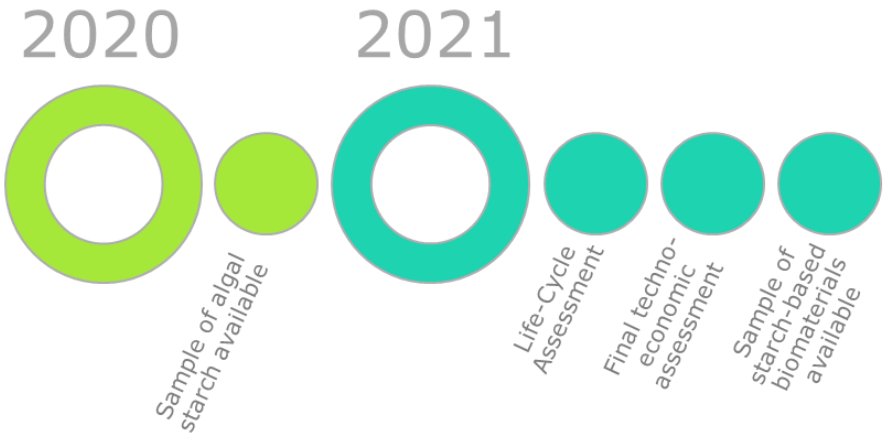
Microalgae suspension from photobioreactors

Microalgae broth from fermenter

Final powder product

Microalgae paste after centrifugation

MEWLIFE*NEXT STEPS*



INSIGHT*HIGH-ADDED VALUE PRODUCTS*

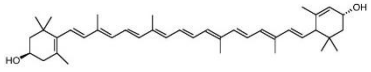
The use of **microalgae biomass** as **food source** is an ancient practice, especially in Asia and North America.

Around the 1950s, microalgae were considered a promising candidate for protein supply in the human food chains. In the 1960s commercial cultures of microalgae were started in Japan (*Chlorella* and *Spirulina*) followed by *Arthospira* in the 1970s. At this stage, the single cell protein was the main product that targeted the industry, with applications directed to food and prophylactic use.

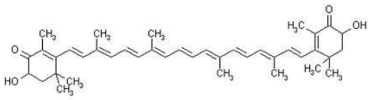
Later, in the 1980s, the pigments production emerged through the cultivation of *Dunaliella salina* and *Haematococcus pluvialis* with focus on β-carotene and astaxanthin applied to human food, animal feed and chemical-pharmaceutical industry.

In the early 1990s, started the production of polyunsaturated fatty acids with focus on docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) for use in aquaculture feed and enrichment of nutritional products.

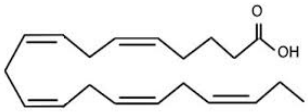
Currently, the most important microalgae-based product for use as bioactive food compound is single-cell protein (whole dried biomass) sold directly as dietary supplements. Also, several emerging bioactive compounds (phycoerythrin, fucoxanthin, beta-glucan, and exocellular polysaccharides), not yet marketed, are shifting their research and development status to achieve commercial exploitation in the coming years.



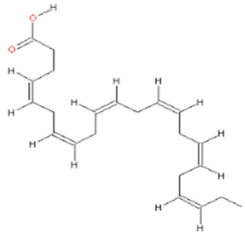
Lutein



Astaxanthin



Eicosapentaenoic acid (EPA)



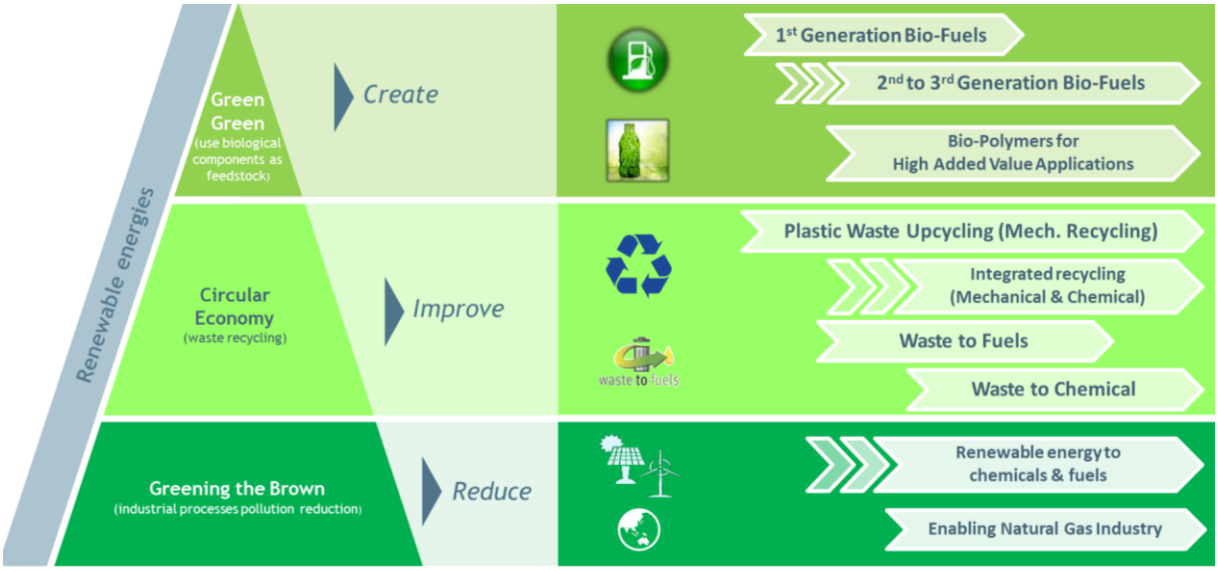
Docosahexaenoic acid (DHA)

INSIDE*PROJECT COORDINATOR*

NextChem is Maire Tecnimont company dedicated to Green Chemistry and energy transition which will manage technological initiatives to best address new market dynamics.

The company is active in a series of initiatives aimed at: **Carbon Footprint Reduction**, mitigating the environmental impact of the technologies used for oil and gas processing; **Circular Economy**, implementing mechanical recycling of plastics and promoting chemical recycling; **Bio-fuels**, identifying oil substitutes to produce bio and renewable fuels from biomass feed-stocks.

NextChem portfolio of technologies includes a catalyst process to convert H_2S rich gas into sulphur and hydrogen, a dual pressures cryogenic process to separate CO^2 from natural gas and a catalytic/thermal process to convert natural gas into olefins.
NextChem has developed proprietary technologies for the Upcycling of industrial plastic waste and for the conversion of urban waste (non recyclable plastics and refuse derived fuel) to synthetic gas, hydrogen and methanol.
NextChem is acting as a technologist and engineering contractor, able to develop, industrialize and commercialize new technologies and then filling the gap between the lab and the market.



For more information visit the company website**:** **www.nextchem.com**

INSIDE*PROJECT PARTNERS*

BIO-P	**BIO-P** an **innovative start-up** of Maire Investments Group. It is mainly dedicated to the study and development of new technologies concerning the biotechnological sector; its focus is on the development of technologies concerning the formulation of new biopolymers of both plant and microbial origin and of nutraceutical compounds of plant origin, more specifically of microalgal origin. The sectors in which BIO-P operates include: *(i)* beta carotene, astaxanthin and lutein from microalgae *(ii)* study of starch extraction systems from microalgae and its pre-processing for application as an ingredient in the formulation of bioplastics *(iii)* study of biomaterials formulated with natural fibers.
HTR HIGH TECH RECYCLING https://www.chem.uniroma1.it/ricerca/centri/htr	**High Tech Recycling (HTR)** is an interuniversity research centre founded in 2007 and coordinated by Prof. Francesca Pagnanelli. HTR joins together researchers from different Italian universities (La Sapienza of Roma, University of L'Aquila, University of Genoa, University of Marche, University of Cagliari, University of Bologna) and the National Research Council (CNR). HTR researchers operate in the development of innovative processes in the field of byproduct, wastes and wastewaters valorization and circular economy.
LABOR INDUSTRIAL RESEARCH LAB http://www.labor-eu.net/	**LABOR** is a private industrial research and engineering laboratory providing engineering, consulting and technology development specifically targeted at SMEs operating in the EU, in order to boost their growth at a European level through technological innovation. The Engineering and Development team consists of electronic and mechanical engineers, computer scientists, laboratory technicians and industrial chemists. A network of technology partners and centers of excellence at European level support the qualified staff of the company.
MEGARA RESINS ANASTASSIOS FANIS S.A. https://www.megararesins.com/	**Megara Resins** is a diversified manufacturer and supplier of raw materials for industrial and architectural coatings as well as rosin based and other synthetic resins for the paint, adhesive, printing inks, paper and construction industry. For over 40 years, Megara has been a pioneer in creating innovative technologies to help coatings formulators meet the requirements for the most demanding applications. The company is widely regarded as being the most innovative Greek supplier to the coatings industry through its continued investment in R&D, technical support and new product development. A highly proficient team of senior scientists is dedicated to research in the field of binders for diverse applications to providing our customers with the most innovative, highest quality value-added products and services possible.
TS http://www.technosind.it/	**Technosind** was founded in 1990 in order to coordinate R&D activities mainly in the field of recovery of raw materials from waste and in the field of renewable energy. Its main core is the development of innovative processes from the laboratory scale up to the industrial one. The skills of Technosind are documented by a wide and qualified international experience, in a context of strategic projects funded by the EU. Almost all of the turnover comes from R&D activities commissioned by private and public companies. The company constantly collaborates with "La Sapienza" University of Rome, in the field of energy storage, nanotechnologies and the treatment/reuse of urban and industrial wastewater.

INSIDE*PROJECT STAKEHOLDERS*

The "**Associazione Frantoi Oleari Lazio**" (ALFO, President: Paolo di Fonzo) agreed to contribute to the project development providing in total 40 m^3 of olive oil mill wastewaters (OMWW) produced by the 3-phases olive oil production plant '**Cooperativa Agricola Sant'Antonio**' located in **Rocca Massima** (**LT**). The interest in the project was also confirmed by Mr Paolo Mariani (Asso.frant.o.i / Associazione Laziale Frantoi Oleari) during the MEWLIFE round table at Ecomondo expo in November 2019.
During the olive oil production campaign 2019-2020, about 20 m^3 have been collected, transferred and pre-treated by LABOR in the revamped membrane prototype. The resulting concentrate and permeate streams will be then used by BIO-P as input for algae growth in the heterotrophic cultivation section.

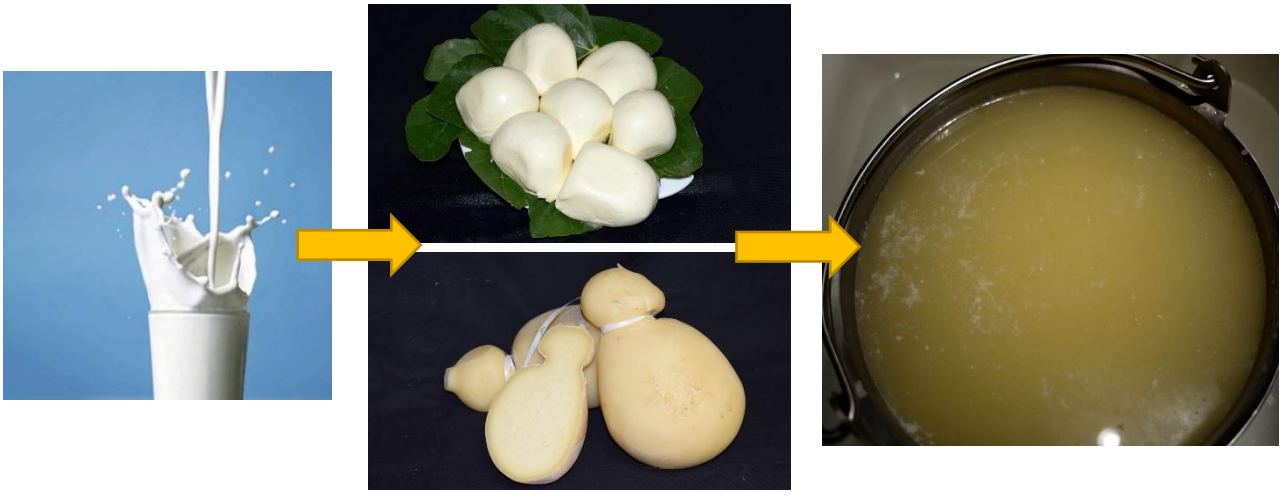
Paolo Mariani speaking at Ecomondo2019.

Tanks provided by LABOR at mill site for filling with OMWW.

MEWLIFE noticeboard installed at olive mill site.

For more information visit: http://alfofrantoilazio.it/

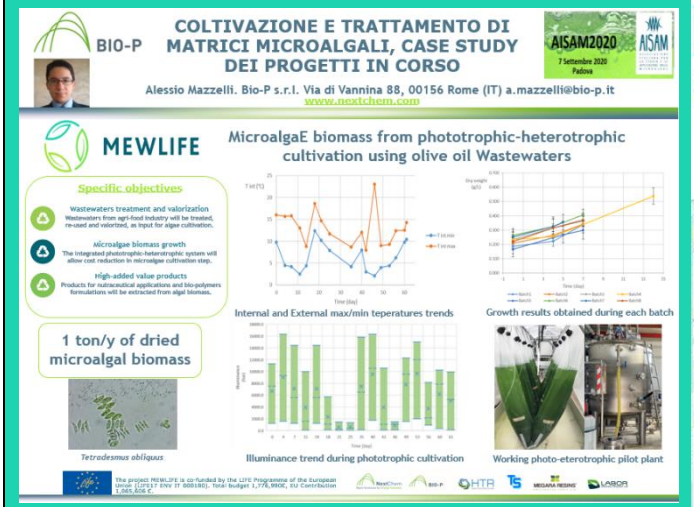
The "**Caseificio Campo Felice**" agreed to contribute to the project development providing whey from dairy production in Lucoli (AQ, Italy). During the experimental campaign, whey, eventually pre-treated by LABOR in the revamped membrane prototype, will be used by BIO-P as input for algae growth in the heterotrophic cultivation section as alternative input or in addition to OMWW.

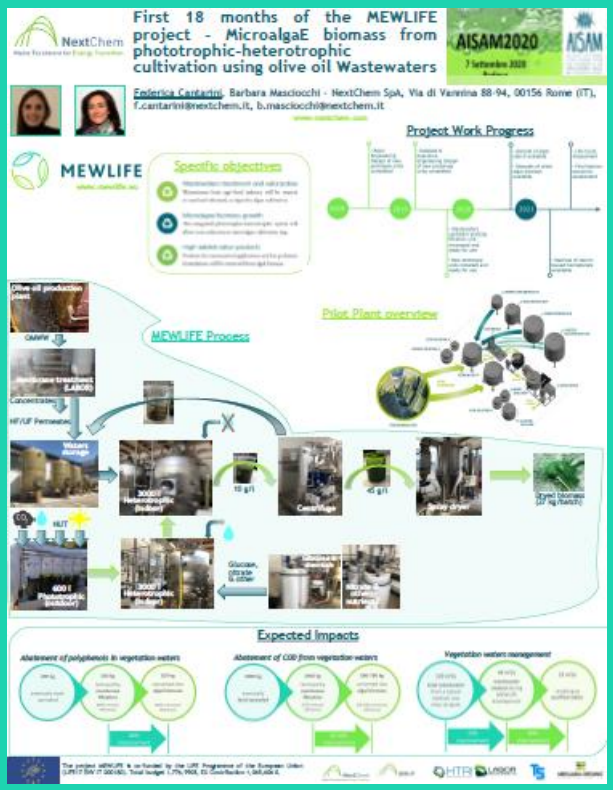


Dissemination activities

1. F. Di Caprio, P. Altimari, G. Iaquaniello, L. Toro, F. Pagnanelli, (2019). *T. obliquus* Cultivation Under Heterotrophic Conditions: Determination of Growth Parameters. **ICheaP 14** *(14th International Conference on Chemical and Process Engineering), Bologna, Italy* (Oral presentation).
2. F. Pagnanelli (2019). High Tech Recycling Center in MEWLIFE PROJECT: demonstrating new strategies enhancing feasibility of microalgal cultivations. **ECOMONDO**, Rimini, Italy (Oral presentation).
3. F. Di Caprio, P. Altimari, F. Pagnanelli (2019). Control of bacteria growth in heterotrophic microalgae cultures by uncoupled nutrients feeding. **AlgaEurope 2019**, Paris, France (Oral presentation).
4. F. Di Caprio (2020). Microalgal cultivations integrated with wastewater treatment: the example of the MEWLIFE project. **AquaFarm 2020**, Pordenone, Italy (Oral presentation).
5. F. Di Caprio, P. Altimari, F. Pagnanelli (2020). Control of bacterial contamination in heterotrophic microalgae cultures by cultivation in a sequential batch reactor. **AISAM 2020**, Padova, Italy (Oral online presentation)."

The MEWLIFE project has been presented by NEXTCHEM and BIO-P at AISAM2020 conference "*Research and production: universities and private companies meet to cooperate in the field of microalgae applications*" - **7 September 2020, Padova, Italy**. AISAM2020 has been organized by AISAM – Associazione Italiana per lo studio e le applicazioni delle microalghe.





For more information visit: https://www.aisam-microalghe.it/it/aisam2020.html

For more information, please contact:

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Email: b.masciocchi@nextchem.it

You are in this list because of the interest in the MEWLIFE project

Website: www.mewlife.eu

The project "MicroalgaE biomass from phototrophic-heterotrophic cultivation using olive oil Wastewaters – MEWLIFE" is co-funded by the LIFE Programme of the European Union (LIFE17 ENV IT 000180).