

MaCuMBA

MaCuMBA is a four-year research project that aims to uncover the untold diversity of marine microbes using cultivation-dependent strategies. This joint venture of 23 partner institutions from 11 EU countries is led by the Royal Netherlands Institute for Sea Research (NIOZ), and has a budget of more than €12 million, of which €9 million is funded by the EC Seventh Framework Programme.

project news

www.macumbaproject.eu

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Marieke Reuver (WP9 Leader) and MaCuMBA Coordinator, Prof Lucas Stal

Welcome to the special industry focused issue of MaCuMBA Project News!

Marieke Reuver (AquaTT), Chair of the MaCuMBA Exploitation Committee and Leader of MaCuMBA WP9 Dissemination, knowledge management and linkages, outlines the importance of industry collaboration for this project.

Welcome to this 10th issue of **MaCuMBA** project news in which we have focused on how **MaCuMBA** is contributing to the marine biotechnology sector. Having an impact on this sector is an important aspect of **MaCuMBA** as we work towards exploiting the results of our research on culturing the uncultured and improving the cultivation of other marine micro-organisms to enable the screening of interesting organisms and their compounds.

The effective transfer of novel research discoveries in the field of marine biotechnology can greatly improve Europe's capacity to generate new commercial opportunities, so badly needed in crisis stricken Europe. In addition we also aim to strengthen the awareness of marine biotechnology results and applications across European industries, particularly for SMEs.

In this issue we profile **MaCuMBA's** industry and SME partners. SMEs and industries make up a significant

part of the **MaCuMBA** consortium, ensuring that the project focuses on the interests of these partners. The participating SMEs are research intensive and highly innovative companies. They are marketing new and innovative products for the biotechnological industry such as: food, pharmaceuticals, cosmetics, bioenergy, materials, and fine chemical production. We hear from them as to why a project like **MaCuMBA** is beneficial for the marine biotech industry and how **MaCuMBA's** research results could be exploited.

A recent industry-related activity **MaCuMBA** has undertaken is the organisation and facilitation of an industry round table at the BioMarine 2014 event which took place in Cascais, Portugal from 30-31 October 2014. BioMarine is an annual international conference where CEOs and executives from all areas of the marine sector have the opportunity to meet stakeholders in the marine bioresources sectors and professionals in the marine industry. This is a platform for research and industry alike to diversify their cross-sectorial knowledge, strengthen their existing partnerships and build new opportunities. The 2014 event was therefore an excellent opportunity for **MaCuMBA** to build new relationships and promote and transfer the innovative outcomes of the project to key stakeholders.

Professor Lucas Stal, **MaCuMBA** project coordinator, and I coordinated the round table session. During the round table, target outputs of the **MaCuMBA** project that have potential industrial relevance were presented and practical industrial development of these outputs was discussed with participants.

In this issue of the newsletter we hear from the BioMarine organiser Pierre Erwes and Bruno Ferreira, a participant at the round table. They tell us how **MaCuMBA** is being perceived by the industry and what they think are the most promising and exciting aspects of the research being carried out by **MaCuMBA**.

I hope that you find this issue of our newsletter to be informative, and if you would like to know more or to discuss any aspect of **MaCuMBA's** work, please contact me directly: marieke@aquatt.ie

Marieke

Potential Industrial Impact and Exploitation of MaCuMBA Activities

A major impact of **MaCuMBA** will be providing access to the underexplored microbial biodiversity and bioactivity of the marine environment. Developing new cultivation approaches will enable the easy access to marine microorganisms, thus avoiding highly expensive repeated isolation.

MaCuMBA will also develop protocols for sample preservation and isolation from remote oceanic regions and environments that were hardly accessible until now. This will lead to a culture collection of new isolates.

Areas of Expected Impact

➤ Food Industry

Marine organisms are important sources for healthy nutrition. Marine microorganisms may provide interesting food additives, both as the whole organism and as individual compounds for functional food additives. Improved cultivation will enable rapid exploration in this field. The use of marine microorganisms as animal foods or probiotics should also be considered here, especially their role in aquaculture.

➤ Bio-Energy Industry

Today the production of biofuels from cyanobacteria and phototrophic microorganisms may present a promising option to harvest this huge energy resource. The marine environment contains the largest diversity in this field. However other marine microbial functions may be of interest too, such as the production of methane by archaea.

➤ Environmental Remediation Industry

Environmental remediation deals with the removal of

Exploitation Committee

MaCuMBA has a dedicated Exploitation Committee which ensures efficient exploitation of the project's results. It is also responsible for creating and implementing the Intellectual Property Rights (IPR) strategy by evaluation of opportunities for innovation and exploitation and is responsible for ensuring that the results of the project are exploited in the most efficient manner. The Exploitation Committee consists of three members from industry, the project coordinator and the WP leader for dissemination and exploitation (WP9), who is also the chair of the Exploitation Committee.

Studying cell-to-cell communication, co-cultures and use of culture techniques that mimic the natural environment will provide nutrient and media additives to stimulate cultivation.

Different platforms for high throughput screening for isolation, improving cultivation and selection of microorganisms are being developed. Each of these will allow industry to rapidly investigate the opportunities that marine microorganisms have to offer.

pollution or contaminants from environmental media such as soil, groundwater, sediment, or surface water. Most applications today rely on microbiology, such as for mitigating oil spills. Cultivation of the right marine organisms will enable exploration and exploitation of this virtually unexplored field.

➤ Human Health Industry

Marine organisms have been the source of important and novel compounds for a range of medical (e.g. anti-tumour, blood pressure reduction, anti-bacterial, anti-viral) and veterinary applications. Major challenges facing pharmaceutical discovery from marine bio-resources are linked to the quality of marine resources.

➤ Industrial Products and Processes

Proteins, small molecules, and enzymes from marine organisms already contribute significantly to industrial biotechnology. Organisms and their compounds (lipids, enzymes, polymers as polysaccharides) from extreme environments and atypical ecosystems have especially proved to be of interest. Nano-materials may also be produced with high precision by marine microorganisms.

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Meet MaCuMBA's Industry Partners

The **MaCuMBA** consortium consists of 24 participants, including seven SMEs and industry partners. Here we get to know these industry partners and their roles within the **MaCuMBA** project.

Cyano Biotech



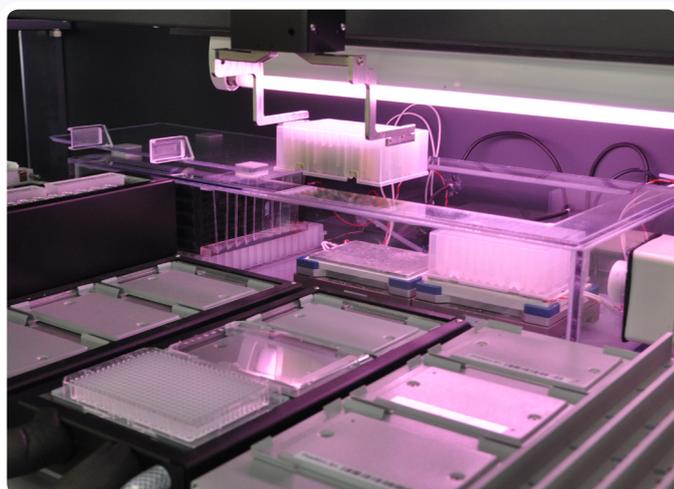
Cyano Biotech is a biotechnology company based in Berlin, Germany. It is engaged in the discovery and development of natural products as lead substances for the development of novel pharmaceuticals in collaboration with the pharmaceutical industry. Furthermore the company is active in agrochemical, functional food, cosmetics and fine chemical research and supply. Cyano Biotech focuses on cyanobacteria as a source for novel natural products. Dan Kramer, its co-founder explains the company's role in MaCuMBA.

Website: www.cyano-biotech.com

What is the role of Cyano Biotech in the MaCuMBA project?

Our main responsibility relates to the establishment and testing of robotics for isolation of unialgal microalgae from complex environmental samples and their screening for natural products in a high throughput manner.

We have been successful in the establishment of a robot for picking single microalgal colonies grown on agar plates as well as in the establishment of a microcultivation



Automated cultivation system developed by Cyano Biotech

platform for the cultivation of strains in deep-well microtiter plates (dw-MTPs) in combination with pipetting robotics for culture sampling, feeding and dilution respectively.

We have also been successful in sample preparation and sample loading of templates for subsequent matrix-assisted laser desorption/ionisation time-of-flight mass spectrometry (MALDI-TOF-MS) analysis. The final step now relates to the combination of the single components of the isolation robotics into one fully-integrated system. We are confident that we will succeed in achieving this in the second quarter this year (2015).

What are the benefits for industry partners of being part of an EU-funded research project such as MaCuMBA?

As a biotech SME active in a new field of R&D (the discovery of novel bioactive compounds in cyanobacteria as a new source for natural products), we consider close collaboration with universities and academic institutions as being of utmost importance for innovation and for gaining the know-how and experience needed for successful R&D. In this regard the **MaCuMBA** project is very impactful and supportive because of its interdisciplinary nature and because it brings together worldwide leading experts in their respective fields.

How could the research you are conducting within MaCuMBA be exploited by industry?

The main advantage for industry of our R&D within **MaCuMBA** is related to the much higher throughput and simultaneously the reduced effort needed for isolation and screening of microalgae (especially cyanobacteria). In the past this has been a major bottleneck harming the commercial exploitation of microalgae for the discovery of new compounds for the pharmaceutical and agrochemical industry (e.g. identification of new antimicrobials or new pesticides) but also for the food and cosmetic industry (e.g. identification of new antioxidants or anti-aging products). Overcoming this bottleneck will make a significant difference and will make the diverse group of microalgae much more attractive for the respective industries.

PharmaMar



PharmaMar is a biopharmaceutical company based in Madrid, Spain, which explores the seas to find innovative treatments for cancer. PharmaMar's **Dr Fernando de la Calle**, Head of Marine Microbiology R&D, Drug Discovery Area, outlines the company's contribution to the **MaCuMBA** project.

Website: www.pharmamar.com

What is the role of PharmaMar in the **MaCuMBA** project?

PharmaMar is taking part in many of the **MaCuMBA** work packages to analyse marine biodiversity, develop innovative technologies to isolate and culture bacteria and molecular tools for the characterisation of each isolate, to improve understanding of how the microorganisms communicate and finally, of course, to provide the consortium with access to our screening platform for selecting organisms with potential cytotoxic metabolites.

In particular, our work within the **MaCuMBA** project is focused on biodiversity analysis and drug discovery using a specific class of relevant industrial bacteria, named actinomycetes, which are being isolated from deep-sea sediments (collected from more than 1,000m in depth). Currently, we have generated a collection of more than 1,500 different actinobacteria using our experience to mimic natural conditions by the addition of several growth factors to solid plate discs. Furthermore, some of these actinobacteria have shown activity in our antitumor screen, suggesting that deep-sea bacteria can produce new antitumor metabolites.

Particularly interesting is the fact that we have identified several potential new species of bacteria from the marine biodiversity studied.

Finally, we are developing innovative strategies to use genomic mining as a compass for selecting the most interesting candidates for drug discovery. Our significant effort in this area is being further explored within Micro B3 (www.microb3.eu), another complementary marine biotech EU-funded research project, with the tools and knowledge gained being applied in both projects.

What are the benefits for industry partners of being part of an EU-funded research project?

Without any doubt, one of the most important benefits is the transfer of know-how and the chance to collaborate



PharmaMar have identified several potential new species of bacteria from the marine biodiversity studied

with many partners all working at the cutting-edge of their field.

The cutting-edge science developed by academic research centres represents a fantastic source of new innovations and is often the starting point for identifying new applications that can be taken into development within a biotechnology company such as PharmaMar.

Furthermore, our increased knowledge of marine biotechnology and particularly marine genomic resources opens up the new possibility of using bioinformatics to perform "in-silico" screening to identify interested genes and generate new applications and new products.

How could the research you are conducting within **MaCuMBA** be exploited by industry?

Much of the research being conducted within **MaCuMBA** is directly related to the pharmaceutical industry and the search for new medicines to treat cancer, bacterial infections and other diseases. Other industries that use enzymes could also benefit from new or improved enzyme activities discovered using **MaCuMBA** technologies.

The cosmetic industry can also benefit from marine biodiversity and the use, for example, of anti-inflammatory marine substances obtained from the culture of almost uncultivable marine organisms. Potential also exists for molecular reagent industries to make use of new extremophile proteins from the rare varieties that some **MaCuMBA** partners are working to "domesticate". The bioremediation and food industries must be considered too.

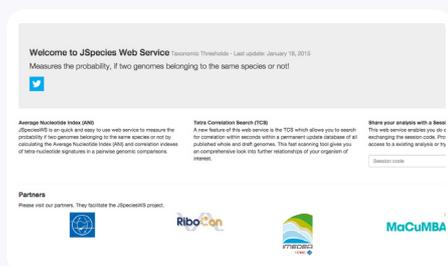
Ribocon

Ribocon is a professional bioinformatics services and solutions provider for microbiology, serving academia and industry worldwide. Jörg Peplies, Co-founder, CEO, and technical head of Ribocon, discusses the company's contribution to MaCuMBA.

Website: www.ribocon.com

What is the role of Ribocon in the MaCuMBA project?

Ribocon focuses on the computer-based analysis of DNA sequences (genetic information) from bacteria and other small organisms. This can be the analysis of selected marker genes e.g. the identification of bacteria, or even the analysis of complete genomes to assess the functional capacities or other characteristics of these organisms



Screenshot of JSpecies Web Service

started, to use the potential of extensive DNA sequence analysis such as genome sequencing to learn more about microorganisms of interest (i.e. which genes are present and what is the genetic/functional potential of an organism?). Our main focus in the project is the building of new bioinformatics tools specific for the requirements of **MaCuMBA**.

Specifically, we have set up a web service called JSpeciesWS which allows users to compare within seconds the average similarity of a newly sequenced bacterial genome against a curated reference data set of most publicly available bacterial genomes (>9,000), representing the core of the application. Based on suggested thresholds, it then can be assessed whether a new species is present or not. In the past, this was done by cumbersome laboratory-based methods. Taking into account that presumably more than 90% of the microbial diversity on earth has not yet been discovered, and that when looking at bacteria using a microscope it is nearly impossible to distinguish them, such tools significantly advance the work of microbiologists. This is especially crucial for **MaCuMBA** since the main task of the project is to enhance the ability to bring microorganisms into pure culture and with this many new microbial isolates will be produced for further characterisation.

Within **MaCuMBA** we share our bioinformatics expertise and infrastructure to support other partners that plan, or just have

The service is freely available at: <http://jspecies.ribohost.com/jspeciesws>

What are the benefits for industry partners of being part of an EU-funded research project?

From our perspective, there are two major benefits. First, the structure of EU-funded research projects facilitates the interaction and collaboration of the partners involved. Activities are bundled in work packages with clear tasks which are assigned to the individual partners and which are usually linked to, or even based on, each other. This helps a lot to build up an international network of scientific and industrial partners which is important for us as an enterprise acting in a global market.

Second, DNA sequencing and analysis is a fast evolving, highly dynamic field. Participation in such cutting-edge scientific projects allows us to keep up with the latest developments as well as the current requirements and the upcoming trends of the field.

Altogether, EU-funded research projects represent a perfect melting pot for SME partners with a focus on technological development.

How could the research you are conducting within MaCuMBA be exploited by industry?

The reliable identification of microorganisms is a central aspect of the quality control routine, for example in the pharmaceutical or food industry, and is often even regulated by public authorities. At the moment, industry is increasingly using the modern genetic-based approaches for these tasks because of the advantages (accuracy and often also speed), and even for specific requirements complete genomes are sequenced.

However, the analysis of DNA sequences is mainly based on searching an unknown query sequence against a known reference data set, and ultimately the quality of public databases is not matching the formal requirements of industrial routine applications. This is because the main sequence repositories are built by users submitting DNA sequences and there is a lack of stringent standards for the accurate annotation of these submissions. In the worst case, error propagation then causes a snowball effect. On the other hand, these repositories are also of major interest for industry applications because of their comprehensiveness. Therefore, Ribocon is shaping public reference data sets by extensive quality control and correction of wrong or missing sequence-associated information to align them with the industrial requirements.

SeaLife Pharma

SeaLife Pharma is a privately held marine biopharmaceutical company based in Austria. SeaLife Pharma is focused on the discovery and development of novel, marine bioactive compounds. Structure isolation, testing and characterisation in different screening and analytical platforms were then performed to isolate compounds of interest for further research. Therefore SeaLife Pharma combines broad expertise at all relevant levels from basic research to clinical development. Alex Pretsch, the company's CEO, details SeaLife Pharma's activities in the MaCuMBA project.

Website: www.sealifepharma.com

What is the role of SeaLife Pharma in the MaCuMBA project?

SeaLife Pharma is mainly responsible for screening and identification of bioactivities in the anti-infective, immunomodulatory and neurodegenerative field. Additionally promising candidates are being screened in several pre-clinical test systems addressing genotoxicity and general toxicology. Besides the testing activities, SeaLife Pharma will also isolate coral microbes and ferment them by mimicking the coral mucus layer; using a new way to obtain neglected bacterial strains.

What are the benefits for industry partners of being part of an EU-funded research project?

EU projects are a good opportunity for industry to look beyond its own nose and see what is going on in the scientific field. Large consortia offer a good way to discuss and solve problems that could only be covered by heterogenic research groups. For companies, EU projects provide an ideal umbrella, addressing all legal and budget aspects, to work together in such large consortia.

How could the research you are conducting within MaCuMBA be exploited by industry?

The identification of novel microorganisms, the establishment of new fermentation conditions and the isolation of novel compounds will help to identify new drugs. At the moment we have an enormous lack of novel pharmacophores especially in anti-infective therapies.



Dr Miroslav Genov from SeaLife Pharma conducts chemical replication synthesis.



Polymaris Biotechnology

Polymaris Biotechnology is a French company specialising

in biotechnology which is developing and commercialising innovative biopolymers, and especially exopolysaccharides (high-molecular-weight polymers that are composed of sugar residues and are secreted by a microorganism into the surrounding environment) produced by marine bacteria from its private collection. Dr Bertrand Thollas, the company's co-founder outlines the contribution it is making to the MaCuMBA project.

Website: www.polymaris.com

What is the role of Polymaris in the MaCuMBA project?

The objective for Polymaris as part of MaCuMBA is to

discover new molecules (exopolysaccharides) which could potentially be produced by bacteria collected by the various partners. First of all, Polymaris purifies all strains sent by the partners and then we determine which strains are able to produce these biomolecules. Each of the interesting strains are then cultured in fermenters to make them produce a small quantity of biomolecules. The exopolysaccharides are then purified and analysed to give them a chemical identity.

What are the benefits for industry partners of being part of an EU-funded research project?

Being a partner in a European project allows us to be part of a network of scientific experts and to use this shared knowledge to speed up certain research projects.

How could the research you are conducting within MaCuMBA be exploited by industry?

Molecules discovered as part of MaCuMBA could possess biological or physico-chemical properties which may be interesting for various markets.



Microdish

MicroDish BV is a biotechnology company based in the Netherlands that has developed microcultivation methods for microbiology. **Colin Ingham**, a founder of the company and CSO, discusses some of the innovations that it has developed within the project.

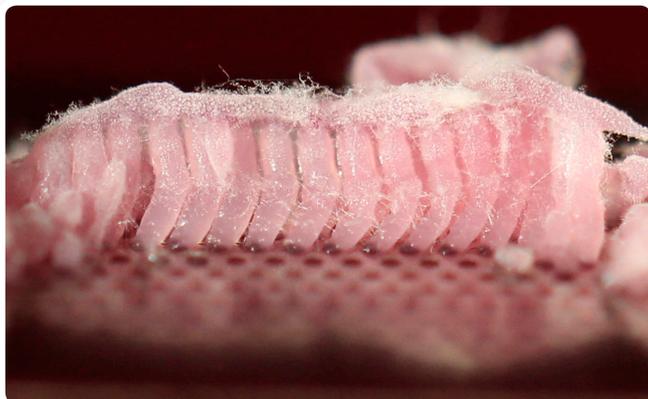
Website: www.microdish.nl

What is the role of MicroDish in the MaCuMBA project?

Our role as a SME in **MaCuMBA** is to use microcultivation techniques, and in particular the MicroDish Culture Chip (MDCC, arrays of miniaturised Petri dishes on a chip), in improving microbial culture from the sea. Cultivation technologies try to deal with the issue that the marine environment is a rich source of natural products but the producing microbes can be hard to grow. We try to find new and commercially interesting microorganisms, to help grow previously cultivated ones in new ways, to find new commercial properties, and to be involved in the creation of new devices. In all these areas we operate in-house and also work collaboratively with other partners.

What are the benefits for industry partners of being part of an EU-funded research project?

Access to collaborators and expertise is critical in a company where the focus tends to be narrower; it is very helpful and stimulating to interact with academics and other companies openly within the **MaCuMBA** forum. The project provides publicity too. It is good to use the project as a testing ground, a way of generating high quality scientific data and identifying commercial routes both in disposable products and in biodiscovery.



Marine Eukaryote growing on an MDCC (cultivation chip). This is a **MACUMBA** isolate, obtained during the sampling activity in Roscoff in 2013 from a sponge sample. The circular areas are 180 microns across wells with a porous ceramic base and the image is around 7 mm across



An MDCC placed under a dissection microscope for examination of microcolonies

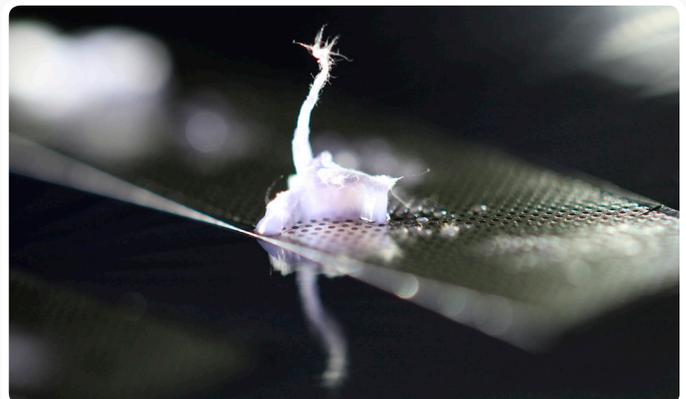
How could the research you are conducting within MaCuMBA be exploited by industry?

We have worked in several parts of the **MaCuMBA** pipeline, on creating new devices, isolation/strain improvement protocols, and screening. The result is a set of methods and a strain collection. We hope these techniques are more widely used and the strains will be shown to have value.

We have produced a how-to-guide for biodiscovery using our techniques or devices (cultivation chips). This is being constantly updated and rewritten with feedback from the project.

How could this knowledge output be exploited by industry?

We hope that this approach will break the mindset that conventional cultivation techniques are the obvious way forward to finding useful, new microorganisms, and that microfabrication techniques for building "better Petri dishes", as developed within WP8 of **MaCuMBA**, are an emerging toolbox for microbiologists.



Marine Eukaryote growing 6 mm above the chip (which is 8 mm wide, wells 180 microns as before)



BioMarine
Business Convention

MaCuMBA BioMarine 2014 Round Table Session: “Marine Biotech: novel strategies for marine microbe cultivation”

MaCuMBA led a round table session at the Fifth International BioMarine Business Convention in Cascais, Portugal, on 30 Oct 2014. As part of this special issue of MaCuMBA Project news, an industry representative who attended the round table session gives us their feedback and Pierre Erwes, Executive Chairman of BioMarine, gives us his insight into the marine biotechnology sector in Europe.

Pierre Erwes, BioMarine



Pierre Erwes, Executive Chairman of BioMarine

Pierre Erwes, Executive Chairman of BioMarine, gives us his insight into the marine biotechnology sector in Europe.

What is the current status of the marine biotechnology industry sector in Europe?

Marine biotech is developing very fast. But, in saying that, we need to be careful and read between the lines. The European Commission is funding a lot of projects, which sometimes gives the impression the sector is booming. The reality is quite different. Most of the time when the funding from the EU is over, the project tends to disappear and there is no value creation. Real entrepreneurial spirit is lacking and risk taking is definitely not the main driver for the professionals of H2020 funding.

Despite this we still have an emerging industry which is configuring; if we consider the protein needs for aquaculture, for example, the demand is driving development. Unfortunately aquaculture is still not widely considered as a component of the marine biotech sector. Seaweeds are another example: the demand for feed is fast growing and the extraction of biomolecules is following the trend.

As I mentioned previously, the numbers we are showing in

Europe are misleading: marine biotech should encompass marine aquaculture developments, the aquafeed industry and the remediation sectors. It would also make sense to include Norway in the final numbers, as it is one of the largest contributors and most of the promising developments come from them.

What do you foresee for the future of the sector?

The sector will benefit from the very fast development of aquaculture which also includes seaweed production. The demand for feed, nutrition and personal care are the key drivers; representing tremendous potential in terms of short term profits and job creation. Europe will have to become more flexible when it comes to regulations if we want to have a chance in the global competition. Why should we try to develop a new product in a zone where regulatory and environmental constraints are so tight? The barycenter is moving steadily towards Asia, so it's time to tear down the wall we have been building around Europe. The last question mark is funding. What will happen to a global player which is pouring public money into research with no private relay or private equity ready to jump in? Again we need to attract fresh cash and give our European regions the right tools to build clever access to money.

How do EU-funded projects such as MaCuMBA contribute to the development of the marine biotechnology industry sector?

MaCuMBA is an example of an EU project which could really make a difference. The concept is appealing and attractive enough for SMEs and corporations to jump in. BioMarine was proud to present MaCuMBA in Cascais last October and we realise how important it was to bridge our investment and industry sector with research.

Round Table Participant: Bruno Ferreira, CEO Biotrend



Bruno Ferreira, Biotrend



Can you provide a brief description of your company/role in industry?

Biotrend is a research-based company focused on the development, optimisation, de-risking

and scale-up of bioprocesses for industrial biotechnology applications. Clients range from start-up companies without bioprocessing know-how and infrastructure to large chemical and pulp and paper companies exploring opportunities to create value from the use of renewable raw materials, including industrial by-products. Additionally, Biotrend invests in internal projects to create its own IP portfolio.

Biotrend has tremendous experience in dealing with naturally occurring microorganisms (including those from marine environments) and complex raw materials, namely plant-based hydrolysates, to implement fermentation-based processes, for the effective production of microbial biomass, specific chemicals or value-added products. Our experience makes Biotrend an important player and partner in the emerging marine biotechnology sector, as we can help validate processes from lab to pilot scale (from 1mL to 250L fermentation capacity in-house) and beyond, and carry out essential process intensification to improve

the process robustness and productivity and reduce process costs, all crucial aspects for the process transition to commercial operation. Further, our broad experience with different and complex raw materials enables us to swiftly devise the most effective sequence of operations for the treatment of materials such as residues of marine bioproduct processing industries to enable their use as fermentation substrates.

What attracted you to the MaCuMBA round table event?

The MaCuMBA round table devoted to novel strategies for marine microbe cultivation met the core interest of Biotrend's activities in marine biotechnology. Biotrend was particularly interested in discussing novel strategies for the identification of promising activities from new marine microbes and improving the "hit rate". We were also curious about the project's advancement towards the potential commercial developments that could emerge from the project. Finally, it also provided a networking opportunity with potential partners or clients.

From an industry perspective, what do you think are the most promising/exciting aspects of the research being carried out by the MaCuMBA project?

From our experience while executing work for clients and within the Bluegenics FP7 project (www.bluegenics.eu), the screening of microorganism activities and the assessment of their commercial potential (i.e. not only detect an activity but quantify whether the performance is higher than existing molecules or platforms) are key to foreseeing translation to a commercial setting. The tools being developed in MaCuMBA can provide a significant contribution to this.

www.biotrend.biz



MaCuMBA Round Table session at BioMarine 2014



Partner Update: Heriot-Watt University

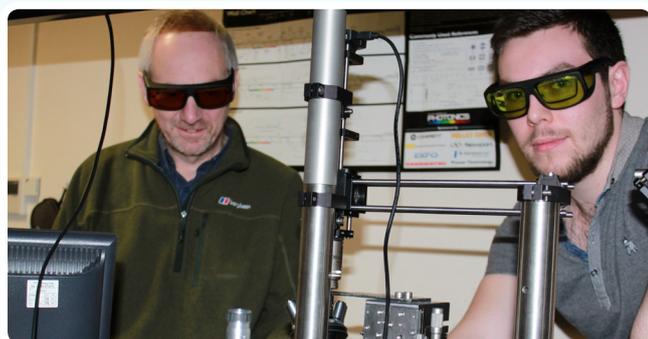


Dr Lynn Paterson, Heriot-Watt University.

Dr Lynn Paterson, head of the Biophotonics group, within the Institute of Biological Chemistry, Biophysics and Bioengineering at Heriot-Watt University, explains how the group is tackling the issue of isolating single microbes.

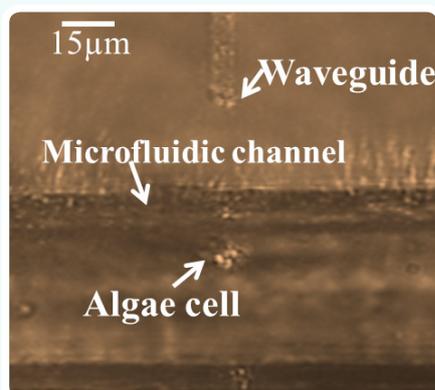
We are approaching the problem of isolating single microbes via two routes. Both make use of the optical force that light can exert on particles. In one instance we have used optical tweezers, also known as a single beam optical trap, to pick up and move a single bacterium, a single yeast or microalga from a crowded sample into a new compartment such as a sterile glass needle or a reservoir at the end of a microfluidic channel. The cell can then be used in further experiments: to culture a colony, for single cell analysis, or to create co-cultures using small numbers of starting cells. We have delivered an optical tweezers system to NIOZ and they are using it to isolate marine microbes. We are currently developing a new, compact and automated system with an extra imaging functionality.

The other tool we are developing is an integrated optical-microfluidic device to rapidly isolate a much larger number of cells than the single beam trap. The devices are made using the technique of ultrafast laser inscription and chemical etching. A specific type of laser beam is focused into a substrate and the substrate is altered such that the modified region can be etched out with acid, creating a three dimensional microfluidic circuitry. Waveguides can also be written into the substrate, allowing us to deliver light into the microfluidic channels. We are exploring



Dr Mike Winson and Calum Ross, a MPhys research project student, optically trapping in the Heriot-Watt lab

circuitry to enable hydrodynamic focusing of our samples of microbes and waveguides to enable selection and manipulation of single cells from a stream, again using the optical force of the beam to isolate cells from a population.



One of Anusha Keloth's ultrafast laser inscribed devices that is currently being tested

We are developing optical tweezers in combination with cell culture microchips (Prof Gerard Markx and Jochen Schuster at Heriot-Watt, and MicroDish) so that three dimensional manipulation and isolation of

single cells can be automated to deliver single cells into specific reservoirs to reduce the current high demand on operator skill and time, making the technology more user friendly. The laser tweezers systems can: a) isolate cells irrespective of culturability, and in principle could be used to isolate every cell in a sample (this is all important if your sample is precious or you want to gain knowledge about the ecology of the sample); and b) isolate one cell at a time; isolating an identifiable single cell allows the microbiologist to be certain that all cells in the culture are derived directly from the initial cell, this is particularly important in determining the diversity of cells in an environmental sample where faster growing species might outgrow more fastidious types.

Our ultrafast laser inscribed devices hold promise to deliver a higher throughput of cell isolation with added functionality for e.g. cell counting or sorting, similar to commercially available fluorescence activated cell sorters but in miniature and at a fraction of the cost.



Anusha Keloth, a PhD student at Heriot-Watt working on ultrafast laser inscribed devices

Marine Micr'Omics for Biotech Applications - Industry Expert Workshop



Organisers: Micro B3, MaCuMBA, PharmaSea

Location: PharmaMar, Colmenar Viejo, Spain

Date: 30-31 March 2015

The enormous microbial biodiversity of marine environments offers an almost unlimited resource of enzymes and bioactive compounds. In line with the development of innovative bioinformatics tools for (meta) genomics analysis based on high-throughput methods, application options of marine microbial knowledge in industry and medicine are rapidly increasing.

This second Industry Expert Workshop, organised in collaboration with the Ocean of Tomorrow projects Micro B3 and Pharmasea, brings together academic and industrial scientists. It aims to further the exchange of current approaches for the discovery of novel microbial strains, bioactives and engineering of marine-derived biocatalysts

with the help of bioinformatics tools. Opportunities and challenges for understanding complex genome data and their application to discover new enzymes and bioactive compounds will be discussed.

Four focused sessions and a cross-sectoral panel discussion are planned:

- Natural products based on marine biodiversity (Dr Fernando de la Calle)
- Environmental biotechnology through marine microbial knowledge (Prof J L Ramos)
- Bioinformatic tools and methods for innovative blue biotechnology (Dr R Kottmann)
- New strategies for high throughput isolation of novel marine microorganisms (Prof L Stal)
- Panel discussion on bioactives of marine origin – opportunities and challenges (Prof M Jaspars)

For more information, visit: <http://www.macumbaproject.eu/macumba-events/micro-b3-macumba-pharmasea-industry-expert-workshop>

Marine Biotechnology Industry Events 2015

Marine Bioprospecting BIOPROSP_15

Date: 18-21 February 2105

Location: Tromsø, Norway

12th Annual BIO Asia International Conference

Date: 24-25 March 2015

Location: Grand Hyatt, Tokyo, Japan

Marine Micr'Omics for Biotech Applications

Date: 30-31 March 2015

Location: Colmenar Viejo, Spain

European Algae Biomass 2015

Date: 22-23 April 2015

Location: Amsterdam, Netherlands

Global Biotechnology Congress 2015

Date: 22-25 July 2015

Location: Boston, MA, USA

15th International Symposium on Phototrophic Prokaryotes

Date: 2-6 August 2015

Location: Tübingen, Germany

9th European Conference on Marine Natural Products (ECMNP) 2015

Date: 24-29 August 2015

Location: Glasgow, Scotland, United Kingdom

Biomarine 2015

Date: 12-14 October 2015

Location: Wilmington, North Carolina, USA

The 5th Annual World Congress of Marine Biotechnology-2015

Date: 6-8 November 2015

Location: Qingdao, China

MaCuMBA Summer School: Sampling, Isolation & Cultivation of Marine Microorganisms, 12 - 24 July 2015, Texel, the Netherlands

The **MaCuMBA** consortium is pleased to announce that the project will host a summer school on sampling, isolation and cultivation of marine microorganisms in July 2015. During this two-week course, participants will have the opportunity to interact with experts in the field and obtain first-hand experience of isolation and cultivation design along with various other techniques.

Course Description

Morning lectures will be given by leading microbiologists who will present their ideas about the design of culture media, single cell isolation techniques, identification, and screening for bioactive compounds and their application by the biotechnology industry.

Demonstrations and hands-on practical work related to these topics will be carried out in the afternoons. In small groups, the participants will discuss and practice different isolation techniques for microbes including open seawater, marine sediments and substrates (e.g. seaweeds). A matrix of different marine systems, isolation techniques and culturing methods will be offered to the participants. Participants will design appropriate cultivation media and growth circumstances for photoautotrophic and chemoauto- and heterotrophic microorganisms. Enrichment cultures, dilution to extinction, batch and continuous cultivation, plate and cell-to-cell communication will be part of the training. Aerobic and anaerobic cultivation will be possible under different environmental conditions. State-of-the-art identification techniques will be available for processing the samples.

Target Audience

Technicians, PhD students and Postdoctoral scientists with background knowledge in microbiology (required) are invited to apply. The course is open to both **MaCuMBA** project partners and external applicants.

Registration & Fee

Please email Frida Kraanen (Frida.Kraanen@nioz.nl) to apply. Applications should include: your name, address, institute affiliation, e-mail address, phone number, short CV and a short description of your research interests (max. one page). We ask applicants from outside the **MaCuMBA** project to include one reference letter.

Registration deadline: 16 March 2015

The selection committee will notify all successful and unsuccessful applicants before 20 March 2015.

The registration fee of **€975** includes:

- ✔ €100 admission fee
- ✔ Meals (breakfast, lunch, dinner and breaks)
- ✔ Transportation by bicycles
- ✔ Social activities on arrival and closing nights
- ✔ Accommodation in apartments of Hotel de Pelikaan

Location

NIOZ will host the **MaCuMBA** summer school at its site in Texel, an island in the north of the Netherlands.

The participants will be accommodated in Hotel de Pelikaan: www.depelikaan.nl

Contact

Frida Kraanen (Frida.Kraanen@nioz.nl)

DATE FOR YOUR DIARY **Third Industry Expert Workshop**
Joint 'Open Science Meeting' and 'Industry Seminar' - Berlin, 27-30 June 2016
Watch this space and the **MaCuMBA** website for more information

MaCuMBA Project News is a newsletter service provided by AquaTT within the framework of the **MaCuMBA** project. The newsletter provides updates on the **MaCuMBA** project and relevant items related to marine microorganisms. The newsletter is published on a quarterly basis and is archived on the **MaCuMBA** website: www.macumbaproject.eu
Please submit any relevant information for inclusion in the next issue to news@aquatt.ie

