BIOMARINE

LONDON SUMMIT 24-25 Oct. 2012

Fishmongers'hall

Final Report

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Note : List of BioMarine 2012 participants available on www.biomarine.org

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Wednesday Oct 24th, 2012

DEBATE - Marine bio-resources: a bright future
Report by David Peggs, research masters student, Plymouth University

Moderator:
Pierre Erwes,
Chairman BioMarine

Dr Maria Hayes,
NutraMara Scientific Project Manager, Ashtown Food Research Centre, Ireland

Denise Leblanc,
General Manager Aquatic and Crop Resource Development, NRC Canada

Dr. Ilaria Nardello,
Coordinator – Ireland's National Marine Biotechnology Programme

Helena Vieira,
CEO Bioalvo, Portugal

After a short introduction, Pierre Erwes, who is replacing Vanessa Berlowitz from the BBC, engages the debate.

Pierre: What can people expect from marine bio-resources?

Ilaria: Bio-resources are driving the current wave in innovation, supporting growth and technology. Potentially new products are available from marine resources such as so called '**superbugs**' new (perhaps unknown) microbes with properties such as antibacterial, antifungal, antiviral and cytotoxic among others . Many areas of the ocean could harbour untapped resources with huge potential benefits and research into these areas should be a main focus of large companies.

Pierre: Denise, you were recently appointed General Manager Aquatic and Crop Resource Development, at the National Research Council of Canada. What are your priorities, and how do you work with industry?

Denise: Setting up partnerships and collaborations is exciting. We need to understand what are the main focuses and priorities of the companies. These need to be explained clearly. Success needs to be defined more clearly in order to move research and innovation forward. How do we know where to focus future

research if there is no clear definition of a successful product? An awareness and integration of knowledge from research to industry and vice versa is needed to succeed in the development of biotechnological products harnessed from the marine environment.

Pierre: Helena, you are a young and dynamic entrepreneur. Why did you choose Portugal to start your business and do you agree with Denise?

Helena: Why not Portugal? Portugal provides an Atlantic coastline on the doorstep with huge potential for undiscovered biotechnological products. We have a good infrastructure with highly qualified researchers carrying out important research focusing solely on Portuguese products. Academia and industry need to work together and focus on the application of knowledge to transfer products with functional properties to market.

***Comment from audience (Prof. Tony Haymet, Scripps institution of Oceanography)*:**
It is fundamental to concentrate on the link between knowledge and innovation.

Pierre: What are the most important challenges?

Maria: Needs for a governmental approach helping applied research and innovation: small companies face problems with regulations which need to be revised and made clear and concise in order to avoid a hindrance to small and medium sized enterprises (SME's). However, this should not be such that European products move away from gold standards of research and products which are produced currently. It's important to continue research into the formulation and edible products… there's little use having products with bad taste and palatability which consumers will not want to buy.

Helena: There's a need for private investment for the research needed to produce sound scientific proof of products in order to bring them to market. Find ways in which to transfer the knowledge from research/industry to the consumer. Ultimately start delivering and not just promising!

Maria: Don't underestimate the ability and importance of research bodies carrying out work which will lead to proof of product. Proof of product is important, as it aims to protect the consumer…. However it is also important that this doesn't inhibit innovation within investors and researchers. There's a need to re-think the European framework in order to make it easier for small businesses to invest in research… too much red tape.

Denise: The NRC of Canada is moving towards identifying exactly what the industry needs, how can researchers solve industry needs and provide relevant information to move the research and funding in the right direction. Closer relationship between industry and research bodies is the way forward.

Ilaria: I agree with Denise that the industry and research bodies must work together to move forward. Researchers and industry alike must foster mechanisms to create this closer relationship and also find mechanisms to transfer knowledge to the consumer.

Comment from audience (Prof Simon Davies, Plymouth University)
As well as industry and research bodies, we must find ways to work with governments and look closely at legislation for the benefit of all involved. Finding common interests between research and industry will create a successful model and benefit all parties.

Comment from audience (Francisco Gomes, Novus International)
Reinforce the points above and stress the importance of reaching out to talented academics which will benefit industry and academics alike.

Pierre: What is next for research?

Ilaria: In the past most biological courses integrated ecology into degree courses but times have changed and there is more of a need to incorporate business and marketing to give biologists a basic knowledge of industry needs. This would be more relevant and important and would help create better links between academics and industry.

Helena: I completely agree with Ilaria, in my experience very few biological scientists have any business skills whatsoever. Yes definitely adding marketing and business into biology degrees would go a long way when it comes to building relationships between industry and academia.

Denise: I completely agree with the last two speakers and we could even create programmes where young scientists can experience industry first hand.

Comment from audience (Tony Haymet):
Not enough business opportunities within the US. Integrate all areas of biotechnology in order to find the needs of industry and researchers.

Maria: We should not underestimate the consumer… we need to work closely with them in order to stream products through. An intelligent labeling system is also an important part of bringing successful products to market.

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THINK TANK ALGAE AND AQUAFEED
"Macro Algae valorization – from the sea to aquaculture markets"

Moderator
Roy Palmer,
CEO Seafood Experience Australia Ltd (SEA)

Moderator
Pr Simon Davies,
Plymouth University, UK

Sponsor
Hervé Balusson,
President & CEO

INTRODUCTION

The incorporation of algae into aquafeed has come in and out of fashion over the past few decades so the aim of the session was to discuss all aspects of this growing and not well understood industry and to agree on four critical areas which will enhance improvement into the future.

It became clear during the discussions of the vast differences on this subject between EU/West where majority is wild harvest and used as hydrocolloids whereas in Asia the majority is farmed and used for food/feed.

The need to concentrate in this Think-Tank on Macro as against Micro was also established however there was a complete understanding that both were immensely important and commonalities can be found between the two. Compared to other types of aquaculture, the production of seaweed (macroalgae) is only surpassed by freshwater fishes and represents over 30 per cent of the world wide industry.

Unicellular algae is a heterogeneous product; a mix of proteins, carbohydrates and lipids. In unicellular algae there is much variation in composition between species/strains and the proportion of these can even be affected by the growing conditions.

Algae (both macro and micro) are excellent sources of Vitamin A, Vitamin B, Folic Acid, Antioxidants and Carotenoids.

Extracts from Seaweed, in a similar fashion to terrestrial plant extracts, have been shown to have a wide range of biological activities. The two major classes of molecules in seaweeds that have the most potential as functional food ingredients are polysaccharides and polyphenolics. Polyphenolics have proven antioxidant activity, and have been successfully incorporated into drinks and other food consumables. Seaweed polysaccharides are unique, abundant, and cost effectively isolated but need to be partially

hydrolyzed for inclusion in various foods due to their gelling properties. Seaweed polysaccharides have been shown to have heparin-like anticoagulation activity, antiviral, immune-enhancing and anticancer activities, cholesterol lowering activity, lipid lowering effects, and blood pressure-lowering benefits amongst many other things.

OBJECTIVES, THE DISCUSSIONS, THE IMPORTANT COMMENTS AND THE POINTS RAISED:

The big question – can macro algae replace fish meal/fish oil in aqua-feeds? Other issues were centered on global issues of regulations, space availability, industry activities, sharing of knowledge, wastage, etc.

- Where do we position algae in the feed industry; is it a fishmeal replacement? Is it a fish oil replacement? Is it a functional feed additive? The solutions to this depends on:
    - Large scale production; required if used for both lipid and protein
    - Nutritional space in the diet; low protein/lipid content may result in insufficient space in the feed formulation
    - Cost; if its more expensive that other feed additives it needs to differentiate itself from other product
- In EU "the biggest market for macro algae is hydrocolloids "and whilst that industry produces many co-products that have the potential for aquafeed inclusion it does not do that. Whereas "In Asia algae is not a new product, they are ahead of the west in utilizing algae". Algae is used, and advertised widely, in everything from foods/beverages to body lotions/face packs.
- Currently production seems untargeted. More information on digestible protein levels and lipid/Omega 3 data needs to be promoted.
- It was put forward to select optimal strains and then refine processes for these**.**
- The question of what functionality was raised:

    - Adding flavour ; a lot of work need doing to make sure it's the right flavour
    - Functionality will be different in each fish species; which is the main species to target?
    - many products that provide functionality to the diet of salmonids there is still a big space in the market for functional ingredients in tropical species.
    - "we need industry to lead and tell academics what they need from the product" and this should include the price of the product and relate to the price of other commodities.

- How will the development and possible future acceptance of GMO terrestrial products affect need for macro algal products
- It was proposed that a big issue was to work out how to process the base product to be left with something usable.
- We need to use low molecular weight molecules. If too high molecular weight molecules are used the product is unpalatable.
- Nutrition is the best market for antioxidants
- The issue with production was raised: with the exception of *ascophyllum spp*. (which can be harvested) only the gathering of 'wash ups' is allowed. The possibility of land based tank

production was raised but only viable of certain species. Off shore production requires overcoming engineering challenges. Important no competition on space with fish production and that two work hand in hand. In Norway there has been work carried out for the past 60 years in collaboration with the authorities that allows harvesting of other species.

- A goal of the EU dossier, technology innovation platform, was to investigate multi-trophic aquaculture, i.e. planting algal beds around sea farm sites. Issues raised with this were that the dispersion of nutrients in the water column was very rapid (within a few meters) and that it is also very site specific, not all sites would be suitable.

OUTCOMES AND RECOMMENDATIONS

1. Functional Feed Properties

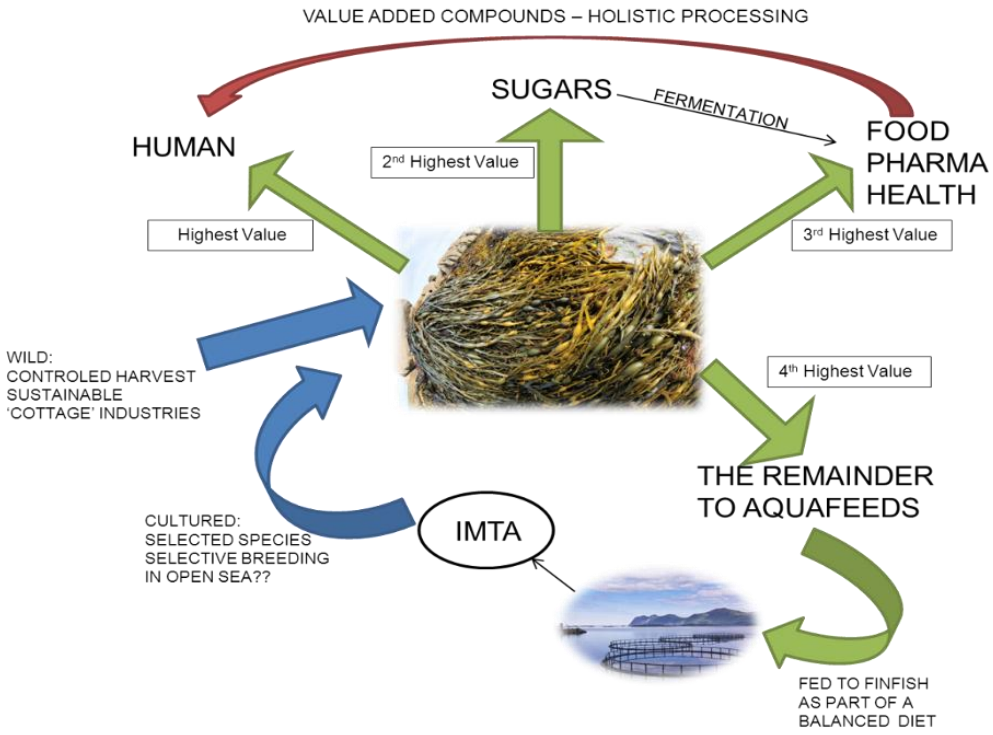
   Construct a benefit-cost analysis (and possibly environmental analysis) that highlights the benefits of Macro Algae and compare with competitive ingredients to promote the importance of the industry. Build a template on the uses and benefits of macro algae to ensure it is seen and understood. Bring the industry closer together to ensure they share and build cooperation.

   - Revise definition
     - Bioactive characteristics / supra-nutritional
   - Protein hydrolyzates
   - Essential fatty acids
   - High value molecules
     - Antioxidants
     - Pigments
   - Prebiotics
   - Trace Elements
   - End Product Quality

2. Capacity

   Create case studies which highlight benefits of holistic approach to build capacity and minimise wastage in this industry which will show the way forward on best practice. Promote new technologies in processing and connect harvesters with end users to ensure maximisation of chain. Build education platform based on increased knowledge and “promote The Sea : The Greatest Field on the Planet (Olmix)”.

   1. Currently a un-holistic approach in Western processing
   2. Driver for the future
   3. Asian approach 100% food with production almost all farmed
   4. Outside Asia 90% for hydrocolloids with production centered on wild harvest
      - creating 35-50% waste
   5. Plan for integrated processing cycle



IMTA – Integrated Multi-Trophic Aquaculture

3. Marketing Strategy

Assembling market knowledge and information on a global website (BioMarine?) to promote and assist the industry internationally to foster best practices and build capabilities in this area. Training and education actions needed to improve internal and external knowledge and understanding and development.

- Understand the product and define, document and validate all claims be they in science, private research, regulations, certification (Standards - food safety, environmental, sustainable, welfare, etc)
- Understand the market and define clients, market and competition
- Survey, explain WIFM and other benefits and get feedback
- Marketing plan should include Brand, logo, Product Statement, Communication/PR Strategy and team organization
- Define and educate your marketing team and beyond
- Continuous improvement process of review essential

4. Legislation/Regulation

Structure the industry around an international organization (BioMarine?) that could foster the emergence of best practices, improve international regulatory aspect, help on IP protection, and

work globally on environmental conflicts to assist development and possible certification. This organization will also foster innovative approaches and help the funding, prioritising research, communication and nurturing of new techniques.

- Lack of global algae federation or regulating body
- Protect technology – Patents/IP
- New products need to be proposed as 'sea vegetable extracts' or the legislation involved in developing a new food source would be a major hindrance.
- Environmental legislation issues with open water culturing and harvesting; altering

Special thanks to Dan Leeming, PhD student at Plymouth University, UK for his help in the note-taking.

Companies attending this think-tank:
ADM - Alltech - Algae Link - Algopack - A-Spark Good Ventures - BioMar - Cargill - CyberColloids - European Aquaculture Society - EWOS Innovation - Fermentalg - Financonsult - FMC BioPolymer - INVE aquaculture - Invivo-NSA - Marelife - Novozymes A/S - Novus International - Olmix Group -Plymouth Marine Laboratory - Plymouth University - Polytechnic Institute of Leiria - Prince Edward Island BioAlliance - Scripps Institution of Oceanography UCSD - Setubio - Seventure Partners - Shannon Applied Biotechnology Centre - Skretting ARC - Sofiproteol - SPF-Diana Aquativ - Tanergy Ltd. - Technopole Maritime du Québec - Thalocea - Varicon Aqua Solutions - Xanthella

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THINK TANK MARINE BIOTECH FOR HEALTH

Moderator
Meredith Lloyd-Evans,
Managing Director Biobridge Ltd, UK

Marine Genomics 4 Users

Partner

INTRODUCTION:

Think-tank 2 focused on Marine Biotechnology and Health. It was led by Mr Meredith Lloyd-Evans, an independent bioscience innovation consultant who is currently Manager of the CSA MarineBiotech, an EU-funded project preparing the way for an ERA-NET in Marine Biotechnology, and a partner for communication and IP matters in PharmaSea, an EU FP7 project focused on streamlining delivery of new marine natural products to end-user companies. The co-moderator was Dr Johanna Wesnigk of EMPA (see TT5). Working groups were assisted by Dr Wesnigk, Helena Vieira of Bioalvo and Dr Antje Labes of GEOMAR.

Three attendees at the think-tank offered to contribute their experiences and views on what were bottlenecks and challenges for the future:

- Russell Kerr, of Nautilus Biosciences Canada, focuses on cosmeceutical and nutraceutical uses of marine bioproducts because these are easier to get to market. When the company has sufficient resources, attention can turn to pharmaceuticals. He pointed out that even though maybe 20,000 new MNPs had been discovered over the past 40 years, only about 4 had made it into clinical use as pharmaceuticals, and challenged attendees why the success rate was so low and what, if anything, could be done. One factor impeding progress is that each company in this area had its own culture collection and its own screens. The implication is that collaboration might help move the whole sector forward, though IP issues can pose problems. However, one benefit has been that the high cost of initial screening has stimulated development of better targeted receptor screens.

- Patricia Calado at BioAlvo Portugal works on products from marine microorganisms from Portugal's continental shelf, including extremophiles. Key issues for the company include the legal aspects of access and benefit-sharing, IP issues, how to ensure sustainable supply, scale-up, and better integration of infrastructures for collection, screening and validation, and increasing the basic knowledge of microbial physiology and taxonomy. Integrated Government policies are also needed.

- Tage Skotvold, of ScandiDerma Norway, represents a newer company, established in 2010. The challenges as seen by Tage are access to soft funding, not just risk capital, using marine by-products as well as marine life, building in-house research capability, establishing appropriate processing techniques that are scaleable, managing regulations, and how to get productive interactions with established industry eg through clusters, which are very useful. Acceptance by the consumer is very important for by-product use, as well.

OBJECTIVES, THE DISCUSSIONS, THE IMPORTANT COMMENTS AND THE POINTS RAISED:

The global market for products from marine biotechnology is forecast to reach over US$4B by 2015. But a successful pharmaceutical product can cost $5B for discovery, development and market establishment (taking into account the cost of all the failed leads). Marine bioresources have a lot to offer to health and wellbeing, but they feed into many other sectors, making marine biobusiness quite complex. In addition to heavy investment in USA on algal biofuels, the OECD has a new initiative in marine biotechnology and the EU's new Horizon 2020 strategy and support programme specifically mentions Blue Biotech and marine biomass as contributors to the economy of the future. But biodiscovery from marine microbes, invertebrates, microalgae and macroalgae is not a simple matter. The BioMarine Think-tank on Health emphasized the importance of joining up the value chain, by creating clusters and public-private partnerships, improving and streamlining knowledge and technology transfer and integrating smaller players much better into the commercial and investment communities they are targeting. Investors also need more information and education about marine bioresources and how they feed into commercial opportunities. This is not new, but the challenges of marine biotechnology come from the origins of the opportunities and the costs and resources needed to exploit them. This immediately indicates the importance of public funding, for example through public-private partnerships, to make Blue Biotech for health a reality for the future.

In the discussion, key topics that emerged were:

- Lack of thinking at the research stage about downstream issues for exploitation
- How to validate the many molecules for the downstream intended uses and therapeutic opportunities
- How to build pipelines so companies are not 'single-product'
- How to link basic and applied research more effectively
- How to take care of the product regulatory needs from the earliest point in the value chain
- How to join up the supply chain efficiently
- Business models and how to manage the cost explosion in pharma development
- If a company begins with one type of product eg cosmetic ingredients, how to manage business conversion to eg pharmaceuticals
- Communication of messages about marine biotechnology prospects to investors and the public, specifically sustainability, 'naturalness'.

Although there had been much discussion about the need for better communication during the plenary part of the think-tank, only one person volunteered for a workgroup proposed on this topic. This is very interesting and suggests we need to follow this up, perhaps in BioMarine 2013 in Halifax.

Workgroups therefore addressed three topics:

- Clusters, networks, public-private partnerships ("Joining up the chain")
- Science, technology and infrastructures
- The commercial context and investment, regulation & IP

OUTCOMES AND RECOMMENDATIONS

Joining up the value chain:

- There is a need for better analysis of each sector's value-chains and the prospects within the sectors, to identify the real low-hanging opportunities and also who are the different players in the chains to whom marine biotechnology can be 'sold'; note that the bioresources sector needs to align itself, for example, in virtual networks (ShareBiotech in Europe) or in non-for-profit organizations (in Canada) to facilitate the growth of successful industry and accelerate commercialization.
- Case studies show that clusters work, but they are better for short value chains and less complex topics.
- For more complex topics with longer value chains, Public-Private Partnerships e.g. of SME, academia and funders, could be effective ways of providing the 'research arm' for partnering with 'large pharma'.
- Technology Centers for marine biotechnology, with specialized infrastructure (for example proteomics, algal breeding expertise), might provide 'one-stop shops' for chain connection. Even if established to focus on one part of the chain, they can manage regional or even supra-regional initiatives, managing projects useful to both sides, thus promoting full value chains.

Science, technology and infrastructures:

- Marine biotech is not being well-served by lack of knowledge amongst technology-transfer offices.
- More fora for meeting of scientists and industrial players would generate better understanding and sharing of needs and possibilities.
- A global source of 'soft' funding would promote the transition from proof of concept to demonstration and commercial-scale for innovations, especially considering the complexity of many marine bioresources developments.
- Specific incubator programmes could be recommended.
- In terms of biodiversity stewardship and research policy validation, we should discourage the use of non-sustainable sources of MBt libraries.

Commercial context – investment, regulation, IP

- The need for long-term stability means that VC and short-term investment strategies are not appropriate either at set-up or for longer survival of new businesses; encouraging business angel groups and raising awareness and knowledge-levels amongst these would be fruitful.
- Smaller players in innovation should consider more collaborations between them, and selling skills and knowledge, rather than pushing molecules at big pharma or trying to go too far down the value-chain; it is usually too difficult for small companies to handle the cost and stresses of regulatory processes

- Nevertheless, the existence of small companies willing to take part in biodiscovery de-risks this activity for big companies and justifies the perceived need for entrepreneurial companies to supply into bigger pharma (and equivalent 'big' companies – food/nutraceutical, cosmetics/cosmeceutical).
- Better and more efficient recognition, development and transfer of academic IP in this area is needed
- The attributes and benefits of MBt could be better communicated. In terms of giving MBt a different image, the higher hit rate could be a starting point

Some of the points raised above were discussed further in think-tank 5 in the context of Marine Biotechnology and the Environment.

Special thanks to Mark Rawling, PhD student at Plymouth University , UK for his help in the note-taking.

Companies attending this think- tank:
Aqua Bio Technology ASA - A-Spark Good Ventures - Algal Bioenergy Special Interest Group - Bioalvo - BioNova - BioTech North - Bretagne Developpement Innovation - CCMar - EMPA - European Marine Biological Resource Centre (EMBRC) - Government of Portugal - Grette Law - innoVactiv - Innovation Norway - JPI Oceans - The Research Council of Norway - Kiel Center for marine natural products - Marealis - Marine Biotechnology Programme of Ireland - Max Planck Institute - National Research Council of Canada - Nautilus Biosciences Canada - Novagraaf Technologies - Novus International - Soliance - Marine Bio-Technologies Center of Innovation - National University of Ireland, Galway - OceanGate, Inc. - Oceanomics project, Roscoff - Polaris - Polytechnic Institute of Leiria - PwC - Roscoff Marine Biological Station - Saint Malo Agglomeration - ScandiDerma AS - Univeristy College Cork - University of Aveiro

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THINK TANK NUTRACEUTICALS
"Omega-3s: Efficacy and purity"

Moderator
Dr Maria Hayes,
Natural Products Chemist,
Teagasc Food Research Centre,Ashton, Ireland

PRONOVA BIOPHARMA

Sponsor:
Emilie Lasson,
Director Business Development Clinical Nutrition and Consumer Health

INTRODUCTION:

The objective of this session was to address key challenges facing international marine ingredients companies. The session aimed to examine bioactive, functional and nutritional ingredients for use in food, supplements and as nutraceutical ingredients. Marketing of ingredients was also discussed along with steps required to ensure the purity and efficacy of the product.

There are concerns and unanswered questions regarding adverse effects associated with consumption of n-3 LCPUFA in terms of safe intake levels, which, may be related to regulation regarding the presence of pollutants. Furthermore, there is a need to inform and educate the consumer about differences in the quality of marine oils that are produced and safe technologies that successfully remove pollutants from these products. The session aimed to provide answers and guidelines for the determination of good quality oils from poorer oils and ways to ensure the efficacy and purity of Omega-3 products globally.

OBJECTIVES, THE DISCUSSIONS, THE IMPORTANT COMMENTS AND THE POINTS RAISED:

Details regarding the numerous good studies that exist proving the efficacy of Omega-3's were discussed. There is a positive growth for Omega 3 products globally due mainly to consumer willingness to purchase Omega-3 products. Furthermore, there is an expanding public awareness of Omega-3's and their health benefits. A limiting factor in the continued success of Omega-3 products is the media perception which is sometimes oriented to sensationalize neutral studies regarding the efficacy and purity of Omega-3 products. These meta analysis are often done on poor scientific grounds, comparing incomparable groups, and that the neutral outcome is due to this and not lack of efficacy of the Omega-3. Despite this the media attention can often be perceived by consumers and can impact on market sales significantly. In Norway there was a case involving a 2 part documentary that looked at the production of Omega-3's in South America. The negative media attention for this activity resulted in a 30 % decrease in Omega-3 product sales in Norway.

In terms of Omega 3 product purity there is a perception that "natural" (non- processed) products are better for the consumer than chemically processed Omega-3 products. This is often not the case. In fact, processing is often required to ensure the safety and purity of Omega-3 products. The group concluded that there is a need to educate the consumer regarding processing technologies used for the purification of Omega-3 products. With respect to this, several members of the group mentioned GOED (Global Association of EPA and DHA) effort around information and education on Omega 3. They aim to educate consumers about the health benefits of EPA and DHA by working with government groups, the healthcare community and the industry, while setting high standards for the Omega 3 business sector. The latter is done by having a voluntary monograph with very strict limits for pollutants far surpassing the requirements in European and US official monographas. GOED is committed to personal integrity, ethical corporate behavior, sustainability of the raw materials, public safety and quality assurance. GOED support a petition to establish clear intake recommendations in North America and advance recognition of the role these important nutrients play in nutrition.

The group also concluded that there is a need to educate the medical community, specifically medical doctors and pharmacists with information concerning the positive health effects and preventative healthcare role that Omega-3's can play in the diet of the consumer. The group recommended that Governments should be enticed to financially support "drives" to educate consumers and the medical profession in particular. This, it was felt by the group, could play a major role concerning consumer uptake of Omega-3 supplement products, in particular.

In terms of the efficacy of Omega-3's and scientific studies, the group felt that there is a need to define the user group in scientific studies concerning the impact of Omega-3 products on consumers. Mainly it is dependent on professionally designed trials with relevant patient or user groups. EFSA's efforts to control the claims that are made and their scientific foundation is therefore a very good initiative. At the moment it is has some start up difficulties and undesired effects, but for the future stringent control of and high scientific standards to claims being made on any supplements both protects the consumer as well as disciplines the industry.

Genetics can play a role in the effect of Omega-3 on individuals. However, the group felt going down the route of personalized nutrition for Omega-3's was way out of scope, while the use of genetics is more relevant in clinical applications, where personalized medicine is a growing segment.

Members of the group felt that a good way to ensure that consumers got their daily recommended dose of Omega-3's was to educate medical doctors regarding the preventative healthcare function Omega-3's could play (as mentioned earlier) and to implement an Omega-3 index as a diagnostic tool could be very useful, this tool is now available, see footnote. This would provide a patient and a potential consumer of Omega-3's would be aware if they were high/low in Omega-3's and they would hear this from somebody they trust i.e., a medical doctor. Consumers and doctors should also be educated regarding the efficacy of Omega-3's (what levels are active and what dose is required) and this would ensure the consumer obtained the correct information to ensure a positive health effect. (1)

The Proposition 65 case in California highlighted the need for standardized, effective labeling regarding the level of contaminants, in particular, heavy metals, Doxines, and PCBs present in Omega-3 products. The entire group concluded that a similar standard should be implemented in Europe and RoW to be sure that the purity and quality of Omega 3 products is ensured. This would also go a long way toward negative media publicity. The audience members stated that GOED Omega 3 was moving towards implementing a purity standardized label globally. GOED was viewed by the attendants at the think tank as a transparency tool that would enable consumers to determine if an Omega-3 product was good or bad. Purity is a big issue for GOED but the attendants at this think tank felt that GOED should include label claims.

The participants felt also that the whole area of stability regarding Omega 3 products and in particular EPA/DHA in supplement products was a future area of research that needs financial input. Stability effects taste and sensory aspects of the final product so improved, consumer friendly formulations are required. It is also necessary to educate the consumer regarding oxidized products or at least, to have information available to the consumer.

Fair trade was discussed briefly and again MSC labeling for sustainable resource management should be in place and will go towards ensuring fair trade. However, it was felt that Fair trade would really need to be implemented by individual governments of individual countries. Sustainability and control over the entire supply chain including raw materials was also a focus of the group. Transparency in traceability of the material securing quality in all parts of the chain was seen as important. GOED also focuses on this, and there was an agreement that the current labeling and certification is probably not sufficient or renown enough to ensure this.

(1) The Gene Smart Omega-3 Index(TM) uses Dr. Harris's proprietary HS-Omega-3 Index(R) methodology -- the same methodology used in the clinical studies that validated the correlation between the Omega-3 Index and heart disease risk. The science behind the Index has been tested and validated by data from numerous large-scale human clinical studies, including the highly-regarded Physicians' Health Study (PHS), which involved 14,916 healthy male physicians.

OUTCOMES AND RECOMMENDATIONS

- Education of consumers, medical doctors and pharmacists regarding the preventative healthcare potential of Omega-3 products
- Standard similar to Proposition 65 worldwide, declaration of pollutants if over recommended level
- Implementation of GOED certification on Omega-3 products

- Financial input by companies and governments regarding research that deals with the stabilization and generation of consumer friendly Omega-3 (EPA/DHA) formulas/products.

- Documentation of scientific claims so that consumers trust in products are strengthened (EFSA)

Special thanks to Benedict Standen, PhD student at Plymouth University , UK for his help in the note-taking.

Companies attending this think- tank:
Ascenta Health - Biosciences KTN - B. Braun Melsungen - Chitin Marine Products Ltd - Concordia Capital LLC - Delhi Nutraceuticals - DSM Nutritional Products - Eurofins - Grette Law - Innovation PEI - Maastricht University - Matahari Technology Consulting - National Research Council of Canada - Norwegian Seafood Research Fund - Polytechnic Institute of Leiria - Pronova BioPharma - Roquette Group - SPF-Diana Aquativ - University of Aveiro - Varicon Aqua Solutions

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Thursday Oct 25th, 2012

THINK TANK AQUACULTURE

"2030 The Aquaculture platform: facilitating significant growth in global aquaculture"

Moderator
Roy Palmer,
CEO Sea food experience, Australia Ltd (SEA)

Moderator
Yves Harache,
2010-2012 Past President
European Aquaculture Society

NOVUS
SOLUTIONS SERVICE SUSTAINABILITY

Sponsor
Thad Simons, CEO Novus International
Francisco Gomez, Director Aqua Business unit

INTRODUCTION

Aquaculture is an important source of income and livelihood for millions of people worldwide as well as a crucial production sector for high-protein food. Indeed, aquaculture continues to be the fastest growing food production sector with an average annual growth rate of 6.6% between 1970 and 2008. In the meantime, the production of capture fisheries has reached a maximum, and is limited, due to various issues. An ever increasing demand for affordable protein sources, particularly in developing countries is well predicted.

Although aquaculture growth is slowing in some areas of the world, especially in some regions like Europe, the activity is going to play a pivotal role in facilitating global consumer requirements of bio-security and sustainable seafood. By far the greatest world growth of aquaculture is currently dependent on freshwater species, such as carp and tilapia but marine aquaculture is more recent and still in its early development. Both activities should not be opposed under "simplistic" debates such as the opposition of herbivorous and carnivorous species, but appreciated globally as positive activities. Space to grow and utilization of water resources are crucial issues which need to be planned with some certainty.

With the ocean covering over 70% of our planet we need to be maximizing the potential of marine aquaculture, not just for animal protein for human consumption, but also to, ensure that essential fatty acids and nutrients only found in products from the sea are available to complement our diets. The use of this resource is fraught with challenges and a new approach must be undertaken to provide a regulatory framework which will enable sufficient space to efficiently combine the best marine bio resource technologies.

This Think Tank was designed to come up with practical recommendations that could be implemented within a three year plan.

Francisco Gomes (Executive Manager, Novus Aquaculture Business Unit, USA) introduced the debate by talking of aquaculture as a dynamic industry and outlining the main issues which the discussions should be based around (addressing and improving public acceptance, financial capital, human resources and regulations and legislation). Francisco's introduction ended with a simple question, how do we achieve this?

The attendees then broke out into four groups to discuss all those issues. After each group had their discussions they specifically addressed one of these issues to present back to the floor in the afternoon session. The rest of this document summarizes the thought processes of the individual groups along with concluding remarks including remarks from the floor.

OBJECTIVES, THE DISCUSSIONS, THE IMPORTANT COMMENTS AND THE POINTS RAISED:

Public Acceptance

It was accepted early on that current the public perceptions of aquaculture activities are generally negative yet as consumable products generally well accepted. This could be due to the media seizing upon negative stories whilst disregarding the mainly positive stories aquaculture has to offer. This may be particularly true for some activists and NGO's who misinform the public with incorrect facts and figures preventing growth of the industry. The groups noted that the NGO businesses, whilst at times can be helpful, have their own agenda's and funding to support. This is the case in USA, Australia and Europe where aquaculture is still seen as 'not normal' and that the oceans should be kept 'natural' and not 'tamed'. Yet in countries where seafood consumption is high, e.g. Spain, Asia, etc. it was felt that such activities were accepted as normal.

This could be solved through effective and efficient communication between all levels of society: from policy makers to the general public. This communication should be proactive as opposed to reactive, educational and informative providing the public with reliable and accurate facts /data which focus on the positive attributes of the aquaculture industry. These messages should be targeted at all generations, but particularly younger children who are arguably more mouldable and who may grow up with a better understanding of the activity. There should be a pro-active agenda to promote positive aspects and tell the "good stories" on a regular basis.

Currently the consumer is receiving mixed information from a range of sources so the industry should be better organized to provide a clear simple message without conflicting messages which result in confusion and negative thinking. To implement this there is a clear need for an international group to provide these clear messages and give the industry a 'brand'. But who is that group?

A popular choice amongst the majority of attendees was the Global Aquaculture Alliance (GAA). However, it was noted that currently this body is predominantly centred on its goals of aquaculture certification so may not be the vehicle required as could be a perceived conflict of interest. Perhaps this is BioMarine? There is a need to employ a public relations person who will adopt this philosophy and also

who may attract funding from public and private investors through this organisation. This would be a much needed boost for the industry.

The average time a consumer looks at a product is less than four seconds. Consumers are likely then to greatly benefit from a hallmark which is instantly identifiable as a reliable and sustainable source. The Aquaculture Stewardship Council program through its strong WWF connections and dialogues aims to transform the world's seafood markets and promote farming practices that minimise their impact on the environment and communities. Others certification groups such as GAA and Global GAP, etc. do similar. The standards they all have (which vary from group to group) seek to increase the availability of certified responsible seafood by providing a credible consumer logo which assures compliance and industry responsibility. In some groups this label comes at a cost. Does the cost and proliferation of labels enhance or confuse the consumer?

A '2-a-week' campaign which could monopolise on the success of the '5-a-day' fruit and vegetable scheme was suggested as an idea. This could be endorsed and supported by celebrity chefs, etc. increasing awareness and promoting the industry and incorporated in a worldwide video.

A positive conclusion was reached that is possible to turn public opinion through pressure, education, lobbying and the correct marketing if the industry worked globally and in unison. There was general agreement that public acceptance is the driver of all themes.

Financial Capital

One of the groups opened up this discussion by looking at the UK. There is a future aquaculture plan for England but currently there is a lack of investment with few initiatives available. It appears that England is not alone, for example North American investment companies see aquaculture as a 'hot topic', however when it comes to the crunch little is done.

Investment is becoming more widely available but banks/investors must go through a learning phase. Some argued that the risk was different for a potential investor due to money, disease, survival etc.; however others disputed this stating that to investors this made no difference since there is risk in most investments. The important action is transparency which creates confidence.

There are three types of capital; investment, financial and insurance. The question proposed is how do we increase all three? Generally banks do not like fluctuations, especially in profits. This identifies a clear need for the industry to manage variables which cause this variation making consistency a key factor for future investment.

Yet aquaculture faces a catch 22 scenario; to attract investment and grow the industry needs to be healthy but to be healthy capital is urgently required. Perhaps the industry needs to observe the economic aspects educating the financial sector with reliable information which investors can then use as a tool.

The industry needs to be self-sustaining. This could be done through consolidation achieving a larger scale and also limit the risk by investing in different markets across geographical regions and different species. An interesting idea was the formation of an 'Aquaculture Bank' which could then provide micro-financing for global projects and initiatives.

Human Resources

The first priority when discussing this topic was to identify the human resources needed as the industry requires a diverse range of specific skills sets. This gives rise to job area bottlenecks. For example there are numerous researchers in fish nutrition, however in areas such as fish health and genetics this is not the case. This kind of job logjam emphasizes the need for strong communication and possibly bottleneck funding and investment in order to maximise these capabilities.

We need to ensure the development of high quality aquaculture at all levels, and this can only be achieved through education. This could be accomplished through vocational courses and industry sponsored internships, scholarships or projects which should be adequately advertised through directories. For example, Novus offer a WAS internship where the winner is given the opportunity to work in commercial locations in Vietnam. Other companies also offer similar projects such as the EDGE (Educating and Developing Workers for the Green Economy, San Diego) program. These internships/ courses must have some sort of career structure with job security at the end. Ultimately progress must be made at the vocational level; perhaps we need to look at Japan and Korea to achieve this. Education at these levels may also address various cultural differences that exist between nations.

The industry should also work with governments on the replacement opportunity from people employed in fisheries to engagement in aquaculture as there are several wins in this. People are used to the products and the value chain system; they have a seafood culture and encourage both industries to work closer together as well as solving labour issues.

Regulation & Legislation

Whilst some see regulations and legislation as the main limit of innovation, others see it as an opportunity to get out of the cyclic nature that aquaculture presents by evening out production making the industry a lot more attractive for investment.

Perhaps one of the main limitations is access to sites and issues with space, especially on the marine coastline where aquaculture must share space which is also used for coastal fisheries, maritime transport, tourism, renewable energy etc.

Another important issue is bringing products to market whilst maintaining food safety and traceability at the global level. The EU and Canada have extremely strict rules and regulations for new products making it difficult to market innovative products. Asia take a more relaxed approach so who is right, Europe and Canada or Asia? One of the benefits of a strict approach is it encourages responsible sourcing and processing, reduction in environmental impact and enables a general baseline amongst

member states. But those in Europe, for example, reclaim a level playing field, where imported product from third countries should match the high safety and environmental standards that European producers are constrained to comply with? In fact it was queried that EU Standards are not reached by many countries in EU creating unfair situation in their own jurisdiction.

Future plans could include the development of aquaculture parks associated with renewable energy projects and offshore, or zoning for aquaculture purposes either within the EEZ or on the high seas. This kind of regulation must have enforcement though. Done successfully this would enable certification schemes that aim to achieve maximum environmental responsibility to aid the consumer in a practical, positive manner.

Currently there are numerous licenses each slightly different from the last for different purposes. This creates confusion so we propose a simplified version providing a 'one-stop shop' for aquaculture related licenses. The one-stop shop would potentially reduce the time to licence, but it must also allow aquaculture access to appropriate sites, for an appropriate duration, and with the facility to change/transfer licences as the sector consolidates.

A point that was briefly touched upon was access to genetic resources and benefits sharing. With the large amount of trade and movement of biological material around the world, who actually owns each resource? For example, most technologies relating to genetic improvement are conducted in the western world but implemented in eastern societies. This issue is likely to become an important one in years to come.

A question was raised relating to Aquaculture v Soccer! Soccer is the world's game and is controlled by FIFA and no matter in the world where the game is played it is played consistently by the same rules and regulations. Why cannot that system be the goal for Aquaculture? The world needs aquaculture as much, if not more, than soccer yet we play on uneven playing fields, to different rules and regulations and then suffer further with trade barrier issues. Surely we can do better than this?

OUTCOMES AND RECOMMENDATIONS

1. Recommendations for Public Acceptance

Structure the industry around an international organization (a role for BioMarine?) that could foster the promotion of best practices and build a global education platform covering internal and external activities ensuring consistent messages are locked in right through from farm to fork.

- ✓ Formulation of Global Group with the ability to promote and speak on industry issues.
- ✓ Be proactive, positive and promote all aspects of aquaculture in consistent fashion
- ✓ Invest in Early Education for children, both internal and external training/education and industry workforce development.

- ✓ Support Accreditation and Best Practice.
- ✓ By Halifax, have a plan re 2 per week and the video

2. Recommendations for Financial Capital

Build the industry by encouraging consolidation and cooperation through all sectors to increase scale and minimize risk. Encourage and assist BioMarine to be a catalyst for engagement between investment and industry with the aim to foster innovative approaches and help the funding and nurturing of new concepts and technology.

- ✓ Consolidate industry to achieve scale and limit risk.
- ✓ Bring industry and investment together in order to educate and engage the financial sectors and investors.
- ✓ Promote specific innovation in funding.
- ✓ Build on the current limitation of financing at all levels.

3. Recommendations for Human Resources

Create the industry around a professional approach that encourages the best people available to be determined to enter and engage. Work globally on skills shortages ensuring that gaps are identified and communicated. Build a framework of human resources that enables the industry to have solid foundation for the future.

- ✓ Identify and promote the shortages in skill sets; e.g. vets, genetics reproduction, processing, production etc.
- ✓ Create a Directory of Education resources and Industry Internships.
- ✓ Consider promotion of people moving from Fishing to Aquaculture.
- ✓ Development of Education at all levels.

4. Recommendations for Regulation & Legislation

Through BioMarine continue to invite people and organisations to 'stretch the envelope' on regulation and legislation building on successes and highlighting failures in order to build a truly global industry that delivers excellence for the global population. Continue to improve international regulatory aspects, adopting innovative approaches and ensuring sufficient space is made available for sustainable aquaculture growth.

- ✓ Build on strong image through Food safety – a consistent safe product.
- ✓ Space is important – engage in Marine Planning and maximize innovation in usage of space.
- ✓ Use Environmental Modelling to support decisions.
- ✓ Promote examples of good legislation.
- ✓ Be aware of Access & Benefit Sharing – relates to Nagoya Protocol.

Special thanks to Benedict Standen, PhD student at Plymouth University , UK for his help in the note-taking.

Companies attending this think- tank:

ADM - Alltech - Aqua Bio Technology ASA - A-Spark Good Ventures - BioMar - Cargill - CCMar - CyberColloids - DSM Nutritional Products - Eurofins - European Commission - Government of Portugal - Grette Law - Imperial College, London - INVE aquaculture - Innovation PEI - Invivo-NSA - JPI Oceans - The Research Council of Norway - Marelife - Mitsui & Co. - Novus International - Olmix Group - Plymouth University - Polytechnic Institute of Leiria - Prince Edward Island BioAlliance - PwC - Roquette Group - Roscoff Marine Station France - Scripps Institution of Oceanography UCSD - Seventure Partners - Skretting ARC - SPF-Diana Aquativ - UK Parliament - Univeristy College Cork - University of Aveiro

BIOMARINE
LONDON SUMMIT 24-25 Oct. 2012
Fishmongers'hall

THINK TANK MARINE INGREDIENTS
"Marine micro algae and Nutrition"

Moderator
Dr Maria Hayes,
Natural Products Chemist,
Teagasc Food Research Centre,Ashton, Ireland

Sofiprotéol,
a sustainable
commitment

Sponsor:
Maxine Roper
Food Innovation Marketing Manager

INTRODUCTION:

The objective of this session was to discuss the use of microalgae and macroalgae in nutrition and as nutraceuticals. The group discussed how future terrestrial sources of food and in particular protein are limited. The ocean may provide a solution. Seaweed farms alone have the capacity to grow massive amounts of nutrient-rich food. Seaweed is not a major source of food globally at present. It is also one of the fastest growing plants in the world. It can grow 9-12 feet in three months. The think tank discussed a number of topics including:

- Environmental and economic opportunities
- Algal biomass suited to production of animal feed and high value human foods and additives.
- Both micro algae and macro algae are well established sources of such nutrition. With the world's population continuing to grow by about 60 million people per year, demand for sustainable, efficient food production continues to grow. Ever increasing strain is being placed on agricultural systems' capacity to deliver affordable food and nutritional products. Not surprisingly, the World Health Organisation has identified diminishing food security as a major threat to mankind over coming decades.
- Increasing algae food and feed production, by expanding upon existing markets and by creating new ones, to be significant.
- Use of Proteins from micro and macroalgae and associated drawbacks regarding their use which include harvesting. The group decided that aquaculture could provide a solution.
- Transfer of seaweed proteins/oils to human consumers through dietary intervention in animal products (e.g., feeding a pig/chicken/cow/hen seaweed/seaweed ingredients to increase the level of fatty acids (EPA/DHA) or bioactive protein in meat/milk/egg products that are more acceptable to the consumer, particularly in countries such as France where nutraceuticals are not fully accepted.

OBJECTIVES, THE DISCUSSIONS, THE IMPORTANT COMMENTS AND THE POINTS RAISED:

The group discussed the importance of discovering novel and unique uses for micro and macroalgal products and resources to justify the economic costs associated with harvesting and processing marine derived ingredients. This will be necessary if industry players want to compete with other sources/companies producing nutraceuticals and functional foods from non marine resources such as dairy companies.

The TT participants agreed that a future area of growth for macroalgal and microlalgal producers is the area of animal nutrition. Protein resources are in demand globally and marine algae may provide a new, novel and alternative protein source to the currently available dairy and terrestrial plant protein resources. However, the group concluded that future research into the use of marine macroalgal/microalgal protein sources is required as macroalgae in particular, can contain antinutritional factors and plant lectins. An advantage for microalgal derived protein is that they may not have anti-nutritional factors such as phlorotannins and plant lectins associated with them and therefore would be suitable for use in animal feed and animal nutrition. The group decided however that in some instances macroalgal protein is suitable for animal nutrition. For example, sheep in the Orkney Islands of Scotland are known to graze on seaweed and in fact, seaweed is the primary source of nutrition for these animals. Furthermore, there are reports in Tasmania where farmers have reduced their farm veterinary bills through feeding seaweed (*Ascophyllum nodosum*) to cattle and farmers have not observed any negative side effects.

The group also discussed how feeding microalgae/macroalgae to farm animals in order to provide the health benefit of microalgae in human food is a good approach as using the animal as a nutraceutical/functional food vehicle is more acceptable to the consumer. However, if this approach is used, further scientific evidence must be provided to ensure that the health benefit and correct dose of the nutraceutical is being delivered to the human consumer. The group also discussed the importance of ensuring that the sensory and functional quality of the animal product, be it an egg, steak, milk product is not negatively affected by the animal consuming the seaweed/microalgal bioactives or the seaweed/microalgal raw material. The group discussed how Omega-3s in eggs in the USA was a good example of how this approach was very successful.

The group also discussed how production costs are a bottleneck towards developing the use of microalgae/seaweeds as functional food ingredients. The group discussed how production costs could be driven down by integrating technology with good resource management and total resource utilization.

Further research is required to ensure that amino acids/bioactive peptides/lipids from macro/microalgae are bioavailable and contain an amino acid content that is favorable to the consumer. This is necessary to justify a price premium if marine nutraceuticals from algal sources are to compete with other nutraceuticals of terrestrial origin. The digestibility of marine derived proteins/lipids is also of great importance and could provide the resource with an advantage over its dairy competitors.

The group also discussed how strict regulations regarding the contamination of seaweed resources with heavy metals are required and should be implemented. GOED agreement is moving towards delivering this in the future (2013).

OUTCOMES AND RECOMMENDATIONS

- Further research into the delivery of nutraceutical/functional food benefits is required where seaweed extracts or microalgal extracts are fed to the animal. The dose response should be reported.
- Further research is required regarding the effects on sensory attributes of seaweed functional foods on final food products.
- Further funding & research is required regarding aquaculture to overcome the problems associated with raw material supply. This relates in particular to the seaweed resource for use in molecular gastronomy and as a food product in itself. Individual governments must be made aware of this issue and how we can produce food products from seaweeds that can compete with Asia.
- The safety and quality of the seaweed/microalgal product must be ensured and GOED regulations implemented.

Special thanks to Mark Rawling , PhD student at Plymouth University , UK for his help in the note-taking.

Companies attending this think- tank:
AlgaeLink - Ascenta Health - B. Braun Melsungen - Bioalvo - Biosciences KTN - Chitin Marine Products Ltd - Delhi Nutraceuticals - EWOS Innovation - Fermentalg - innoVactiv - Innovation Norway - Maastricht University - Marealis - Matahari Technology Consulting - National Research Council of Canada - National University of Ireland, Galway - Norwegian Seafood Research Fund - Oceanomics project, Roscoff - Polaris - Polytechnic Institute of Leiria - Pronova BioPharma - Roquette Group - Roscoff Marine Biological Station - Saint Malo Agglomeration - ScandiDerma AS- Setubio - Shannon Applied Biotechnology Centre - Sofiproteol - Soliance - Tanergy Ltd. - University of Aveiro - Varicon Aqua Solutions - Xanthella


THINK TANK MARINE BIOTECHS FOR ENVIRONEMENT

Moderator
Johanna Wesnigk,
Managing Director, EMPA Germany

INTRODUCTION

Dr. Johanna B. Wesnigk from EMPA Bremen moderated this think tank. She is a marine microbiologist, now specialized in the management of European projects in the fields of marine, environmental and biotechnological research and development. As part of the scene-setting, she briefly introduced the Marine Genomics for Users (MG4U) and the Micro B3 projects in which she is strongly involved. One focus is on promoting the use of innovative ´Omics and bioinformatics to stakeholders from SME and large industry, especially from the white biotech sectors, for *in silico* activity predictions within Micro B3. Recently many results of marine genomics projects have been made available for the further use of marine stakeholders by the coordination action MG4U.

Her co-moderators were Meredith Lloyd-Evans from the CSA MarineBiotech (see TT2), Prof Frank-Oliver Glöckner, the coordinator of Micro B3, and Dr. Nicolas Pade from MBA Plymouth, representing the Research Infrastructure EMBRC.

Prof. Glöckner introduced the large four-year research project Micro B3, dealing with marine microbial biodiversity, bioinformatics and biotechnology, which started in January 2012. It will promote intense bioinformatic capacity and infrastructure building with and among biodiversity researchers and for novel applications of marine biotech. Key features are ecosystems biology approaches, a bioinformatics information system integrating 'Omics and environmental data, already available for testing, as well as planned model agreements to deal with IPR related to materials, data and databases.

Dr. Pade summarized the benefits of the distributed European Marine Biological Resource Centre (EMBRC) research infrastructure to be funded by member states. This project will offer access to marine culture collections, model organisms, 'Omics platforms, microscopy and further facilities, for both academic and privately funded users. It is still in the preparatory phase and searching for industry input into its service development. It will, together with EU-OpenScreen and Elixir (a new bioinformatics infrastructure, led by EMBL-EBI, UK) provide long-term commitment of European countries and the Commission for research infrastructure services, useful for academia and industry.

OBJECTIVES OF THE DISCUSSIONS AND IMPORTANT POINTS RAISED

To complement the research perspectives, two contributions were made, by J. Rauo from Marealis AS and H. Bisgaard-Frantzen from Novozymes, to identify bottlenecks from a small SME and large end-user industry perspective in how to get more new marine biotech products to the market. Points for discussion were:

- How to strengthen the market push: Should larger industry define their general areas of interest for academia and SMEs, who then target the enabling research and develop specific applications of new marine biotech products & services?
- What are the benefits of marine diversity to the large end-user industries (Novozymes, DSM)?
- What kind of human resources are needed by industry; which can be provided by academia, which by SMEs?
- What kind of research or other infrastructure is needed by industry especially by SMEs?

Case studies for positive interactions between end-users and academia as well as SMEs were presented, with a focus on dedicated workshops or symposia to encourage collaborations.

It was emphasized that technology scouts should "know what they are looking for, but be prepared to find something else" (end user Novozymes). This positive attitude facilitates bridging the gap between the potential of research findings for marine biotech, by informing and inspiring decisions by end-user representatives on which application ideas are worth developing.

Many cluster representatives joined the discussions, stating that bringing about and facilitating dialogue between these communities is one of their core tasks, to overcome bottlenecks in communication and joint developments. The internet and social media might help as new infrastructures in this regard but facilitation of contacts as well as safeguarding IPR is still needed. Clusters can help identify and address the gap(s) between the more scientifically driven proof-of-principle, demonstration and industrial product development, which include successful up-scaling of lab-scale production and providing market intelligence.

OUTCOMES & RECOMMENDATIONS

Recommendations how to promote marine biotechnology for the environment

Issue: How to better understand and make use of beneficial microbes

There is a lack of understanding of microbial marine diversity and their habitats, in short: Who is out there, where are they, how many and what are they doing?

Solutions: We need more academia-industry knowledge exchange on the optimum conditions for sampling, processing and cultivation, based on the habitats of microbes e.g. from anaerobic sediments, from co-habiting with sponges, living on the surface of algae, etc..

- Sequencing to assess what is there, help with *in silico* activity prediction and selection (first promising case studies published, e.g. see MAMBA project).
- Compound screening still needs a high throughput approach, which is only funded if very close to industry. Case study from Geomar, Kiel: as a dedicated marine pipeline for downstream processing

is not feasible, marine compounds were fed into existing pipelines (European Screening Port), showed hit rates of 10%, the rule for terrestrial hits is 1-5 %.

Issue: What kind of human resources are needed for SMEs and large industry to benefit from marine data, for biotech applications?

Knowledge is needed in a coherent way about what is available (networks, including social media marine/biotech-focussed ones, clusters, projects, infrastructures). Large gap(s) between proof of principle, enzyme identified and expressed, and proof of concept: enzyme can be produced cost effectively and in a large enough quantity. How can we bridge the perceived gaps, with funding and financing and/or new combinations of expertise?

Solutions:

- Review and analysis of what is working for improved knowledge flow between industry and academia; facilitation – is it people or (infra)structures? Examples/case studies for best practice and knowledge transfer (NSRC, EU, UK) should be used.
- Need for new expertise can now only be addressed through intelligently combined teams, with more biochemical know how, able to handle sub-sets of 'Omics data for targeted predictions (eg new service SME) and to target market-driven applications.
- Industry to be pro active and flexible: know what you are looking for but be prepared to find something else and be inspired by it.

Issues: What (research) infrastructure is needed for SMEs and large industry to benefit from marine data, for biotech applications?

Efficient up-scaling of production is necessary, but who is responsible for different up-scaling stages, how to get it funded? Here expectations of academia, industry and funders diverge strongly: if production conditions are not economically viable SMEs will not be able to offer a new product to business end-users or consumers.

Solutions:

- Teams (see above) could bridge this gap in conjunction with provision of infrastructure, i.e. mid-scale fermenter-, or proteomics facilities and dedicated service-oriented staff, (if possible with partial government funding of up to 75 %, SME 25 %)
- The next steps in the value chain, if new concept, like algal biorefinery, can still be funded as demonstration/pilot project, via EU funding (partial, 50 %)
- Thereafter proof-of-concept established and further product development has to be driven by market, end-users, large industry.

Issue: How to motivate decision makers to support novel biotech applications?

Scientists are not aware of market interests and pressures; they need to be informed and trained. We need to mould the thinking of a next generation of scientists in a more entrepreneurial way. Business management and other soft skills are missing in many natural science programmes.

Solutions: Training & Education should encompass business-relevant skills:

- This should start at Bachelor level, e.g. one cooperative year in industry (3/4 year), and/or during Master thesis, (case study Portugal: 50 % students' theses in companies).
- internships for at least 3 months in companies as option. The experiences from EU funded PhD networks with two mandatory industry stages are positive.
- Local contests for student-written business plans for marine biotech business. Funding the implementation of the winning business plan.

Issue: Reaching policy makers - Visibility is key!

Solutions:

- Excellent analysis and 'story': consistent, harmonized and easy to understand message(s) on marine biotech, coming from groupings of interests eg Biosciences Network (KTN) in UK, to present cases for policy changes and gap-based funding.
- Understanding existing policy vehicles (eg cross-department government Marine Group in UK, Norway's commitment to 'life beyond oil', France's research 'Alliances') and use information on what exists, to validate the sector and motivate economic/policy commitment.
- The application areas of marine-origin products are very wide –this implies many niche markets with different ways of reaching and motivating the decision-makers for policy and investment, i.e. for environmental monitoring, diagnostics or biocatalysis, specialty chemicals, etc.
- Using media, multiplicators and public opinion, inter alia through events to promote strategy or road map elements as targeted messages and garnished with success stories.
- Introducing consumer-facing standards and certification to create a positive image and motivation for increased demand for products 'from the sea'.

Conclusions:

A session at BioMarine 2013 is proposed covering the unique features and benefits of using marine diversity for industrial biotechnology applications. A LinkedIn group is proposed to develop the themes identified and discussed herein and fine-tune joint strategies to promote marine & environmental aspects. The basis could be case studies – identifying and analysing best practice in order to inform research-industry links, infrastructure efficiency, policy influence and market validation of marine biotechnology.

Special thanks to Dan Leeming, PhD student at Plymouth University , UK for his help in the note-taking.

Companies attending this think- tank:
A-Spark Good Ventures - Algopack - Bioalvo - BioBridge - BioNova - BioTech North - Bretagne Developpement Innovation - Concordia Capital LLC - European Marine Biological Resource Centre (EMBRC) - Financonsult - FMC BioPolymer - Grette Law - Kiel Center for marine natural products - Marine Biotechnology Programme of Ireland - Marine Bio-Technologies Center of Innovation - Max Planck Institute - Novagraaf Technologies - Nautilus Biosciences Canada - Novozymes A/S - OceanGate, Inc. - Plymouth Marine Laboratory - Polytechnic Institute of Leiria - Pronova BioPharma - Roscoff Marine Station France - Technopole Maritime du Québec - Thalocea - University of Aveiro - Varicon Aqua Solutions

BIOMARINE
LONDON SUMMIT 24-25 Oct. 2012
Fishmongers'hall

AQUACULTURE DEBATE

Report by David Peggs, Research masters student, Plymouth University

Moderator
Dr Tiago de Pitta e Cunha,
Advisor to the Portuguese President on maritime affairs.

Francisco Gomes,
Executive Manager of Novus Aquaculture Business Unit, USA.

Mike Velings,
Founder A-Spark Good Ventures, Netherlands

Bernhard Friess, Director "Atlantic, Outermost Regions and Arctic" in DG Mare, European Commission

Torben Svejgaard,
CEO, BioMar Group, Denmark

Tiago: What are the strategic guidelines for aquaculture and how do they relate to funding?

Bernard Friess: Generally there is a growth in job opportunities. However, this may be stagnating and the EU is highly segregated and regional differences are large. The EU has good animal health and food standards generally and has many promising assets for industries to become successful. This is shown through the large EU funding for research. The administration and regulations are proportionate to businesses. Admin policies operating today are fair and we strive to work closely with businesses to finely balance the growth and success of businesses on one hand, whilst making sure the health and safety/regulations/environmentally friendly products etc.. on the other hand are in place to keep the EU's high standards. Furthermore, innovation is an important part of growth and success thus acting as a catalyst for businesses to prosper.

Tiago: Aquaculture is growing and is predicted to supply 65 % of protein by 2030, what needs to be done to ensure sustainability, overcoming barriers, regulations etc…?

Francisco Gomes : First, Governments must reach out to businesses and really discuss the possibility of removing some of the red tape hindering progress. There is no clear regulatory framework in the US in my experience. To set up projects it takes an average of perhaps 3 years…. I could set one up in just a few months in Vietnam for example. There are obvious problems relating to policies and regulations for start-up projects at the moment.

> **The Industry :** Consolidation is a key aspect. We need more flexibility in funding from funding bodies. Asia could provide a lot of answers and potential ways forward regarding policies, funding etc… Innovation, as an industry we must innovate faster and more efficiently.
>
> **Global barriers :** important Market protection. Trade of products must progress faster. Accelerate and differentiate between industries… there are many different species used and they are all different, shrimp are different from salmon etc… What can we learn for other established industries such as salmon to push through faster new species?

To summarise, the three main areas for action are Regulation, Consolidation, Innovation.

Tiago: Aquaculture often faces criticism about sustainability. Is this the case?

Torben Svejgaard : People are always talking about fish in – fish out ratio. It is important to continually show research regarding aquacultures sustainability promise and create close dialog between researchers, industries and stakeholders alike. Make sure we communicate to the wider public what actually aquaculture and aquaculture research does. The aquaculture industry must not hide from the issues such as problems with sustainability. For example, we use soya as a major component of many aqua feeds, but is using soya sustainable? If research suggests otherwise, then let's look at the other options. We need to continuously evolve as an industry and try to always improve the way in which we carry out processing, research and marketing etc…

Tiago: More investment is need for aquaculture, how can this occur?

Mike Velings : There are only a few private investors globally. Public and investors do not know enough about the aquaculture industry. For investors this can mean risks and therefore they are reluctant to put money into aquaculture innovations. Communication is getting better but needs to progress quicker in order to make future investors and the general public more knowledgeable about aquaculture. Long term goals for sustainability are a must for future private investors and the aqua industry must make it easier for both investors and the public to access these goals.

Torben Svejgaard – Going back to the criticism that aquaculture is unsustainable, we here are all talking about long term goals. If this is not sustainability, then what is?

Tiago: How can aquaculture grow through governmental policy? How do we sort out the bottlenecks?

Bernard Friess : It is well known that wild fisheries have been exploited and the need for aquaculture to alleviate these stocks is essential. More aquaculture = less pressure on the oceans and of course this is a good thing. We must go back and look into the obstacles which hinder the growth of aquaculture and review them more closely. Also we need to identify the levers for innovation and find out how they work in order to support them which will in turn help the growth of the aquaculture industry. It is also very important to set up regional advisories.

Tiago :How do we support innovation in aquaculture. What is the future for integrated multi-trophic aquaculture (IMTA), renewable energy and off-shore aquaculture?

Francisco Gomes : There is definitely a lack of funding for innovation. We must look at fundamental research through universities and then apply this research appropriately. And we must look more closely at the mechanisms of how a product works not just sitting back on the knowledge that it works… but we must ask how does it work and how can we therefore improve it in the future. Off-shore and recirculation inland systems have potential but it's all about efficiency. This needs to grow in order to make these areas profitable. We must look at other species of fish especially herbivorous species. In nutrition and alternative proteins, we need to ask the question about the sources we use now, are these the right/only alternatives and what are the other options.

In terms of disease, we have only large vaccine companies for the aquaculture industry. We need more specialized veterinary people for aquaculture. We need more herbivorous species. What can we learn from Asia of alternative species. In terms of IMTA more research is needed into the dynamics involved and whether or not the profits can be high enough.

Tiago: **Fish feeds, where are we now?**

Torben Svejgaard : The last 10-15 years we've seen a large decrease in the use of fish meal in feeds by replacing them with plant based alternatives such as soybean meal. The fish-meal content could perhaps go down to 0% in the near future, for some species at least. However, fish oil is more of an issue and needs to be addressed. Approval of new products in the EU takes much more time than it should and this is hindering the process of creating new alternative feed ingredients. We need more innovation with regards to functionality of products.

Tiago: Red tape, what comes next? Do regulations need to change before investors invest or do investors need to invest in change?

Mike Velings : As investors we look at the global perspective, we are not going to invest where there are too many regulations, in the EU for example, when we can get much more for our money and faster returns

in places with less stringent regulations. The EU needs to change their regulations in order to grow and keep up with other markets in aquaculture.

Comment from audience (Manuel Pinto de Abreu, Secretary of State of the Sea, Portugal): Investment, innovation and regulations need to be looked at in more detail. A new legal framework is needed so that applicants need only apply once speeding up the process. Regions need to focus on relevant species and explore new opportunities in innovation. In Portugal we import 600,000 tonnes of fish and a lot of which we could farm ourselves.
Within one year the regulations and red tape will be reformed to make this possible.

Torben Svejgaard: We as an industry cannot sit back and hope that the regulations change, we need to be innovative in research and keep moving forward as an industry.

Bernard Friess: We must make investments and create innovation and work to change the public perception that farmed fish are bad and wild fish good.

Comment from audience (Clive Askew): We need to consider the possibility of taking advantage of species from lower trophic levels as the effects of such would be negligible.

Comment from audience :The industry needs novel innovation in order to create faster moving research.

Francisco Gomes: Farmers are the basis for the aquaculture industry. Most are conservative and are of the mind-set that if methods work then why change them. Think bigger and perhaps focus on the next generation as well as the current generation. There is a general lack of trust due to past mismanagement of fisheries, so we need to look after the resources and it is paramount that we prove that the business of aquaculture is sustainable.

Tiago de Pitta e Cunha closing thoughts: It seems the aquaculture industry has a long way to go in terms of changing policies and changing public perceptions. But what is clear is that we need to have long term plans for sustainability and at least three of the main areas are as Francisco mentioned earlier **Consolidation, Innovation** and **Regulation** and the aspects to which are encompassed.

BIOMARINE
LONDON SUMMIT 24-25 Oct. 2012
Fishmongers'hall

ANNEX

Special note on the BioMarine London 2012 venue:

The venue for this special event was **Fishmongers Hall, London Bridge, London** – a historical site in terms of what we were discussing and highlighting where we had come from to where we are going in the area of BioMarine.

The Hall sitting alongside the River Thames dating back to Neolithic times with the British Museum having a decorated bowl (3300–2700 BC), found in the River. The river has been recorded with more than 100 fish species in the estuary over the past 30 years, many of these in the river within London. The river has supported human activity from its source to its mouth for thousands of years providing habitation, water power, food and drink and acted as a major highway for international trade.

Fishmongers' Hall sits at 1 London Bridge, where the river stretches to a width of 265 metres, is the home of The Worshipful Company of Fishmongers, one of the 108 Livery Companies of the City of London, being a guild of the sellers of fish and seafoodin the City. The Company ranks fourth in the order of precedence of the Livery Companies, making it one of the Great Twelve City Livery Companies.

Originally built in 1310 the Hall has had a chequered past. A new hall, on the present site, was bequeathed to the Company in 1434. Together with 43 other Company halls, this one was destroyed in the Great Fire of London in 1666 and a replacement hall designed by the architect Edward Jerman opened in 1671. Jerman's hall was taken down when the new London Bridge was constructed in 1827. The next hall, opened in 1834, was designed by Henry Roberts although his assistant Gilbert Scott made the drawings for the new building, and built by William Cubitt & Company. After severe bomb damage during the Blitz, Fishmongers' Hall was restored by Austen Hall and reopened in 1951.

The hall contains many treasures, including the dagger with which Lord Mayor Walworth killed Wat Tyler in 1381, Pietro Annigoni's first portrait of Her Majesty The Queen, a collection of 17th- and 18th-century silver, an embroidered 15th-century funeral pall, two portraits by George Romney, and river scenes by Samuel Scott.