

Second GCC Marine Biotechnology conference: emerging opportunities and future perspectives

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المؤتمر الثاني للتقنية الحيوية البحرية لدول مجلس التعاون الخليجي: الفرص الناشئة ووجهات النظر المستقبلية

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ABSTRACT. The Second GCC Marine Biotechnology Conference was held at Sultan Qaboos University from the 31 October to 1 November 2017. The conference was organized by the Center of Excellence in Marine Biotechnology, SQU and focused on four major themes: (1) genetics and biodiversity, (2) marine biofouling and its prevention, (3) marine natural products, and (4) aquaculture and fisheries. In total, 160 delegates from 23 countries were registered for this conference and 106 delegates attended the conference. In addition to a plenary lecture and three keynote addresses, 39 oral and 30 poster presentations were made. The final session reviewed national and regional issues and identified some of the main challenges in marine biotechnology in the region.

KEYWORDS: Oman; Marine biotechnology; Aquaculture; Biofouling; Genetics; Biodiversity

المستخلص: أقيم المؤتمر الثاني للتقنية الحيوية البحرية لدول مجلس التعاون الخليجي بجامعة السلطان قابوس من ٣١ أكتوبر الى ١ نوفمبر ٢٠١٧. تم تنظيم المؤتمر من قبل مركز التميز للتقنية الحيوية البحرية بجامعة السلطان قابوس وركز على أربع محاور رئيسية: (١) علم الجينات والتنوع الحيوي، (٢) التراكم الحيوي للأسطح المغمورة والوقاية منه، (٣) المنتجات البحرية الطبيعية، (٤) الاستزراع السمكي وعلوم الأسماك. في الجمل، تم تسجيل ١٦٠ شخص من ٢٣ دولة كمشاركين في هذا المؤتمر و ١٠٦ أشخاص كانوا من الحضور. بالإضافة الى المحاضرة العامة والثلاث محاضرات الرئيسية، تم عرض ٣٩ عرض شفهي و ٣٠ ملصق. استعرضت الجلسة الختامية القضايا الوطنية والاقليمية وتم تحديد بعض التحديات في مجال التقنية الحيوية البحرية في المنطقة.

الكلمات المفتاحية: التقنية الحيوية البحرية، الاستزراع السمكي، التراكم الحيوي على الأسطح المغمورة، علم الجينات، التنوع الحيوي

Introduction

The oceans cover 71 percent of the Earth's surface and contain a large diversity of abiotic and biotic marine resources. In spite of this great potential of marine resources, these remain largely unexplored and unused. Marine biotechnology or "blue biotechnology" exploits the enormous genetic, biochemical and taxon biodiversity found in oceans and seas for the benefit of mankind (Allen and Jaspars 2009). Due to the development of novel engineering, molecular and genetic technologies marine biotechnology has experienced a rapid growth in the recent years. It is estimated that marine biotechnology will have a global annual growth rate of 4-5% with a total market value of 3.5 billion euro by 2018 (Global Industry Analysis 2013). In Europe only through the Horizon 2020, Blue Growth Strategy, the EU provided a budget of 145 million euro for the development of marine biotechnology (Greco and Cinquegrani 2016).

The Sultanate of Oman has a coastline of more than 3000 km with highly productive waters and diverse marine bio-resources (Al-Belushi et al. 2015). Living ma-

rine resources are Oman's major renewables and have a remarkable potential for commercial exploitation beyond the traditional fisheries industry. Development of marine biotechnology in Oman can help and generate new materials, isolate bioactive compounds and describe biochemical systems and processes regulations that will have applications for human health, nutrition and future supplies of energy (Al-Belushi et al. 2015). Marine biotechnology can create new job opportunities and thus provide new sustainable sources of income for the Sultanate of Oman.

In recognition of the marine biotechnology potential of the Sultanate, the "Second GCC Marine Biotechnology Conference: Emerging Opportunities and Future Perspectives" was organized by the Centre of Excellence in Marine Biotechnology, Sultan Qaboos University, 31 October – 1 November 2017. The conference was held in Al-Faham Stage, Sultan Qaboos University (SQU), Muscat. This is the second conference in this field organized in the region. The first Marine Biotechnology symposium took place at SQU in November 2013 and 100 participants representing fifteen different countries came to share their ideas and knowledge (Goddard et al. 2015). The main aim of this 2nd GCC marine biotechnology conference was to provide a stage for marine biotechnology, aquaculture and fisheries scientists from the region and other countries to exchange ideas, build

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up new collaborations, and strengthen existing ones between institutes, centers and industries. The objectives of the conference were to assess and promote the development of marine biotechnology in the region. This holds in particular for the prevention of biofouling, the search for marine natural products for various industrial purposes, and screening the genetic and molecular biodiversity of marine organisms for a sustainable aquaculture.

Conference

The 2nd GCC Marine Biotechnology conference focused on four major themes:

1. Genetics and biodiversity;
2. Marine biofouling and its prevention;
3. Marine natural products;
4. Aquaculture and fisheries.

These topics were selected based on current and planned research activities in Oman and elsewhere in the Gulf region. SQU and the Office of Naval Research Global (USA) provided the funding of the conference. Overall, 160 delegates from 23 countries were registered and 106 delegates attended the conference (Fig. 1). In addition to one plenary lecture and three keynote addresses from world leading scientists, delegates presented 39 oral and 30 poster presentations. The organizers of the conference awarded the best student poster and student oral presentation prizes (Table 1). Additionally, the European Society for Marine Biotechnology (ESMB) gave three special awards to deserving young marine biotechnologists who presented their work at the conference.

During the conference, all speakers emphasized that the Sultanate of Oman and other oil-rich countries needed to diversify their economy. Marine biotechnology can provide possible solutions for such economic diversification. It was emphasized that the collaborative studies between biologists, chemists, and engineers are urgently needed and can result in novel marine biotechnological applications and products. Additionally, it is important to close the gap between research and industry. This can be done through academia/industry cooperation such as joint research projects of university scientists with their counterparts in the industry. The keynote speakers Prof. Claire Hellio (Brest University, France) and Prof. Grant Burgess (Newcastle University, UK) presented several successful stories of such collaborative projects between industry and academia. As proof of the benefits of such partnership, several industrial partners sponsored the participation at this conference of several presenters. The challenging part of such joint research between industry and academia is the possible conflicts of interests. This holds particularly true when confidentiality is required by the industry, while dissemination of scientific results is required by the academic research. It was highlighted that open innovation is a useful tool for biotechnology. This will be of benefit for the Sultanate of Oman

and other developing countries. Several models of open innovation have been developed, tested, and presented at the conference.

High biodiversity of marine organisms is at the base for chemical and genetic diversities that can be used to create new products and processes to benefit humanity. Several speakers highlighted that we do not know enough about the species of marine organisms living in the Arabian Gulf and the Sea of Oman, such as microalgae, bacteria, corals, bryozoans and other invertebrates. Only fish and mollusks, the groups relevant for direct exploitation, have received sufficient attention. Many other invertebrate taxonomic groups, which are essential for the development of a marine bio-prospecting effort, were only superficially investigated and local expertise in many cases is minimal. This holds particularly for their molecular and genetic information, which is untapped as yet.

Several presenters clearly identified the array of genetic tools as one of the main mechanisms to study biodiversity and the physiological variability in organisms. The keynote speaker Dr. Roger Huerlimann (James Cook University, Australia) emphasized the importance of environmental DNA (eDNA) for the identification of footprints of marine organisms. By the identification of eDNA through next generation sequencing technology it is meanwhile possible to determine the presence of particular species or communities, such as invasive, biofouling, commercially important, endangered and species of other interest. Such approaches also provide challenges. Some closely related species cannot be separated or identified using these modern techniques yet as in many cases, specific markers have not yet been developed. Environmental factors such as temperature, pH, or UV radiation affect the stability of eDNA and limits its applicability over time as is the lack of reference material, particularly for local species. The plenary speaker Prof. Grant Burgess (Newcastle University, UK) and several other researchers provided evidence that eDNA can play an important role in biofilm and particle formation and stability. It has been shown that enzymes that inhibit production or cleave eDNA can be used for biofilm removal. In combination with antibiotics they can provide a suitable tool to counter microbial infections and to prevent biofouling.

The keynote speaker Prof. Claire Hellio (Brest University, France) highlighted the importance of sufficient supplies of bioactive compounds from marine organisms for the growing and diverse demands of the industry. She demonstrated that the production of bioactive substances from marine organisms in their natural environment could vary with time, locations, and physiological conditions. As it is possible to control the production of bioactive compounds from bacteria and microalgae in the laboratory, it makes these organisations a more predictable source of marine natural products. Synthetic chemistry could be another solution where natural



Figure 1. Participants of the 2nd GCC marine biotechnology conference

compounds could serve as lead substances in diverse biotechnological applications.

Fish and crustacean waste were proposed as potential sources of novel antifouling agents as well as forms of food preservatives. For example, chitosan and chitosan nanocomposites were successfully used to extend the shelf life of some vegetables. Subsequent presentations, demonstrated the high potential of photocatalytic ZnO nanoparticles and nanorods for the prevention of biofouling in the laboratory and field experiments. Toxic

risks assessments of nanomaterials are demanded. A study conducted in Iran suggested that higher temperatures, such as that observed as a result of global climate change, altered the composition, the growth rate, and the biomass of biofouling communities. Among future challenges, it was mentioned that the process of biofouling is complex and requires interdisciplinary research by biologists, chemists, and others. Additionally, there are currently limited links between the industry and academia to exchange ideas and develop innovative anti-fouling coatings.

The keynote speakers Dr. Stephen Goddard (Water Farmers, Belgium) and Dr. Lee Wee (Temasek Polytechnic, Singapore) highlighted that due to human population growth the global need for food and clean water is steadily increasing. The long-term sustainability of traditional fisheries resources became a problem. Aquaculture in re-circulating water is a possible solution that addresses these problems, and provide food security, create value added products, and generate knowledge and sustainable employment. Aquaculture is not a farming approach anymore but became a food production industry, demanding diverse management skills. Freshwater and marine aquaculture can produce among other products, animal and plant food, nutraceuticals and pharmaceuticals, as well as bioenergy and extract nutrients from wastewater treatment. At the same time, there are avoidable negative issues associated with aquaculture, such as natural habitat destruction, increased risks

Table 1. List of conference awards for the best student and young marine biotechnology presenters.

Name/Affiliation	Category	Awarded by
Emily Claereboudt, University of Liege, Belgium	Best student oral presentation	Organizers
Jalila Al-Hadrami, Sultan Qaboos University, Oman	Best student poster presentation	Organizers
Surendraraj Alagarsamy, Kuwait Institute for Scientific Research, Kuwait	Best young marine biotechnology presenter	European Society for Marine Biotechnology
Muna Al Hinai, Sultan Qaboos University, Oman	Best young marine biotechnology presenter	European Society for Marine Biotechnology
Cassy Bakshani, Newcastle University, UK	Best young marine biotechnology presenter	European Society for Marine Biotechnology

of invasive species, and the possible spread of infectious diseases.

Speakers presented examples of novel approaches that could overcome such problems. These include aquaponic, bio-flock and integrated multi-trophic aquaculture management systems. Such novel approaches reduce the overall amount of used water, minimize waste and chemicals usage, as well as allow the production of multiple species, such as fish, shrimps, mussels and agricultural crops. Aquaculture could benefit from recirculating aquaculture systems with reduced or no water discharge. "Waste" from aquaculture can be reused for other purposes. Presenters gave few examples for such approaches. "Fish dew", a fertilizer made of fish waste can provide a revenue higher than the value of the fish that produce it. Another example is chitosan, which is produced from shrimp exoskeleton, and can be used in food, biomedical, and agricultural applications. Urban aquaculture saves space and brings fresh products, such as fish, seafood, seaweed or vegetables, from aquaponic enterprises to the consumers by saving transport efforts.

The conference also identified some of the main challenges in developing a marine biotechnology particularly in the Arab region: lack of collaborative efforts, a very small pool of existing biotechnology industries, a limited sharing of know-how, logistic and financial resources. Most countries in the GCC region are small and only recently embraced scientific research at a global scale.

The region also suffers from a basic scientific infrastructure, a legislation offering often only an incomplete protection of the intellectual property, a still developing framework for fostering international cooperation and are industry-academia collaborations. All participants agreed on the need to organize a workshop between academia, policy makers and the private sector in order to discuss problems and find possible solutions in the future.

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