EurOCEAN 2010
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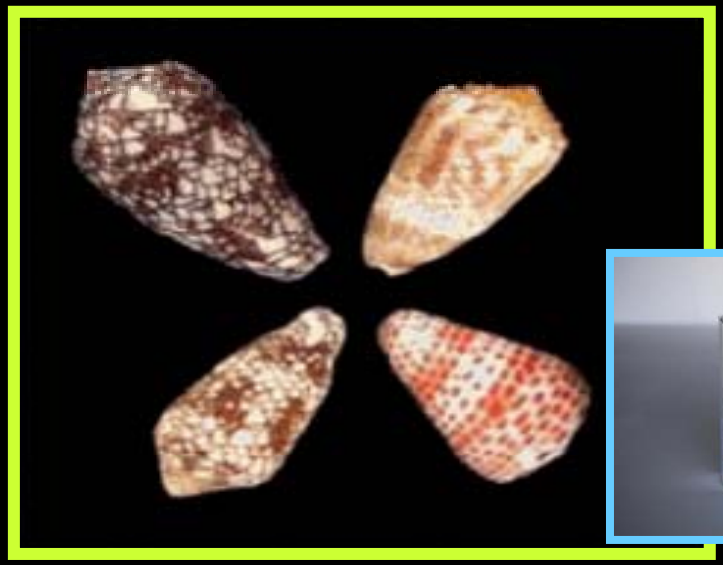
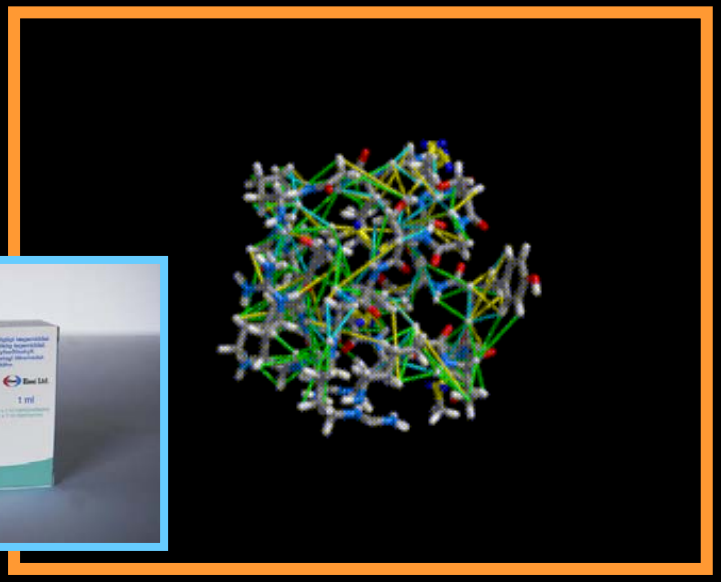
Blue Biotechnology for Europe:

Challenges and Opportunities for Industry and Society

- The use of organisms or their components to provide goods and services
- Application of cutting-edge molecular or genomic biological techniques whereby molecular or genetic material is manipulated to achieve a desired goal.





Historical development of biotechnology

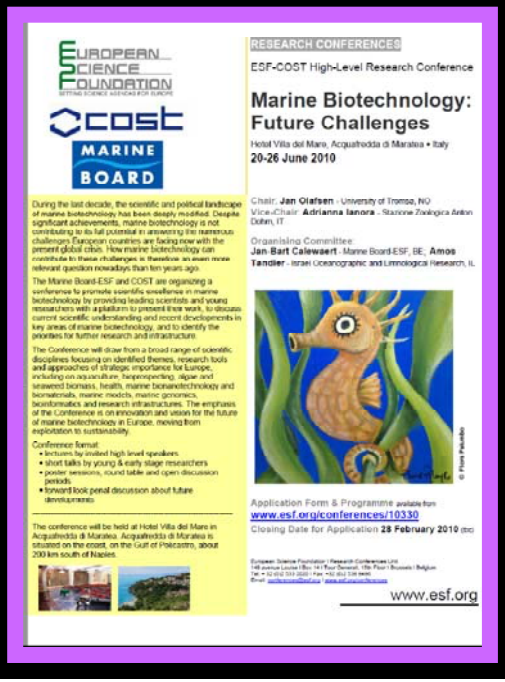
- Babylonians were drinking beer by 6000B.C.
- Egyptians were baking leavened bread by 4000 BC
- Wine was known in the Near East by the time the book of Genesis was written
- In ancient Rome, togas dyed purple were imperial symbols.
- Pasteur- the father of modern biotechnology- demonstrated the fermentative ability of microorganisms between 1857 and 1876
- The new biotechnology revolution began in the 1970 and early 1980s when scientists learned to precisely alter the genetic constitution of living organisms beyond traditional breeding practices

Murex trunculus

State of the Art

- ***Global market currently €2.8 billion (2010)***
- ***Annual growth predicted at 4-5%***
- ***Successes:***
  - ***Anticancer drugs***
  - ***Food and feed (PUFAs/antioxidants/immunostimulants)***
  - ***Cosmetics***
  - ***Microbial enhanced oil recovery***
  - ***Enzymes (PCR/SAP/GFP/antifreeze)***
  - ***Biomaterials (chitin/silica/polymers)***

First Position Paper 2001



Chaired by: Joel Querellou (Ifremer)

Marine Board (Jan-Bart Calewaert)

14 experts in marine bio-engineering, aquaculture, chemical ecology, natural products chemistry, "omics" technologies, bio-informatics, etc.

Scope and Aim:

(i) analyse the main achievements of Europe in Marine Biotechnology

(ii) identify future R&D needs and update the European vision/strategy for marine biotechnology.

(iii) propose recommendations for actions.

1. Health

Yondelis® (trabectedin)

colonial tunicate
Ecteinascidia turbinata

Marine Drugs in Clinical Trials. **Cancer** **Drug-like Molecule**

MoA	Compound	Source	Company	Reference
Oxidative stress inducer	**Aplidin®**	Mediterranean Ascidian	**PharmaMar**	*Monco et al., (2007) Mol Cancer Ther*
Lysosome disturbing	**Kahaladide F**	Sea Slug/ Alga /Bacteria	**PharmaMar**	*Gracia et al., (2006) J Org Chem*
Protein C Kinase Inhibitor	**Bryostatin-1**	Bryozoan/ Symbiont	**NCI/ Bristol Myers**	*Wang et al., (1998) Biochem Pharmacol*
Proteasome Inhibitor	**Salinosporamide A**	Marine Bacteria	**Nereus**	*Fenical & Jensen (2006) Nat Chem Biol*
Microtubule Interfering agents	**Dolastatin 10** **Discodermolide** **Halichondrins**	Sea Slug Sponge Sponge	**NCI/ Knoll** **Novartis** **Eisai**	*Jordan et al., (2005) Mol Cancer Ther*

… and 12 more compounds….

Fernando de la Calle PharmaMar, SPAIN

Other applications for natural products
Neutraceuticals and Cosmeceuticals

-as nutritional supplements including color additives and antioxidants
-vitamins, oils, and cofactors which enhance general well-being
-The carotenoid market alone is projected to reach 77,000 million Euro by 2010

astaxanthin

Dunaliella salina

fucoxanthin

2. Improve aquaculture production

Marine aquaculture is one of the fastest growing sectors in "agriculture"

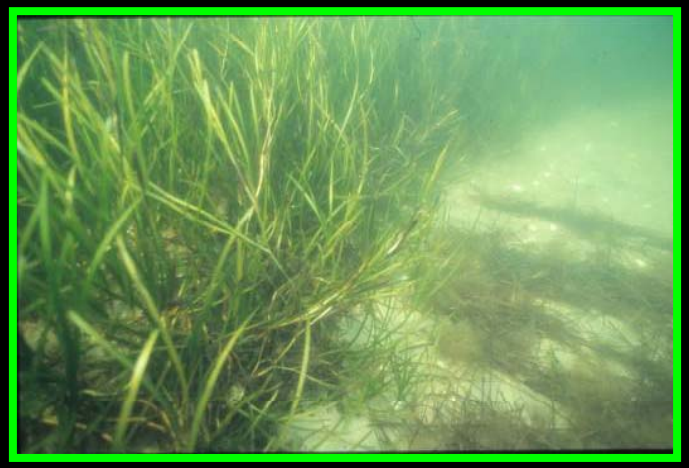
-areas closed to commercial fishing
-increased demand to supply food and high quality wholesome products

In 2007 the EU-27 production of aquaculture increased to nearly 1 306 thousand tonnes (+ 6.3 %) with Iceland and Norway increasing their aquaculture production by 56 %

3. Probing the marine environment

Biotechnology has contributed to marine research in many ways:

1. **Bioremediation after major oil spills**
2. **Monitoring toxic blooms**
3. **Restoration of certain habitats**
4. **Identifying the country of origin of endangered species (forensic biotech)**



4. Energy

Alternatives to fossil fuels may be photosynthetically generated biomass:

1. Microalgae (e.g. Chlorella) are renewable and there is no damage to the environment. Unfortunately, biomass is not economically competitive with current sources of energy.

2. Biomass can be converted by bacteria and microalgae to fuels such as methane and biodiesel

3. Biotechnology may make biomass more viable by enhancing photosynthesis to produce more of a fuel, or modifying biomass to favor fuel production.

Grand Challenges

Many issues must be resolved before Blue Biotechnology in the EU can realise its full potential:

- **Access to very deep specimens**
- **Increased understanding of physiology of marine species**
- **Culturing marine microorganisms**
- **Sustainable aquaculture of algae, fish, shellfish for food, fuels and high value products and processes.**
- **New policies for the protection of marine genetic resources**

Concluding remarks:

Implementing the Strategy

In Europe we are very good at making strategies and plans for the future

We are now at a crucial time where the conditions are as such (infrastructures, capabilities in molecular biology and bioinformatics, ...) that a decisive support via a well developed strategy will allow European marine biotechnology research to make giant leaps forward

If Europe does not act now by increasing its support through focussed funding and coordinated research, it will further lag behind in comparison to other leaders in this field such as the USA, Japan, China etc. – especially Asian countries such as China and India that are investing heavily in marine biotechnology

There is a time for assessing and discussing, there is a time to make plans for the future and there is a time for action and that time is now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Thank you for your attention