Connecting the Dots for a Circular Blue Bioeconomy – Policy Event

AquaHealth – Prof. Dr.-Ing. Kerstin Kuchta

30th January 2024, Brussels

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 817992.

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Results

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Objective

Identification of novel **biofilm-inhibiting** and **antimicrobial enzymes**, as well as **antiviral** candidates derived from microalgae

- Development of **prebiotic** cultures
- As a **natural precautionary treatment** method
- For **sustainable health management** in aquacultures

Photo: TUHH

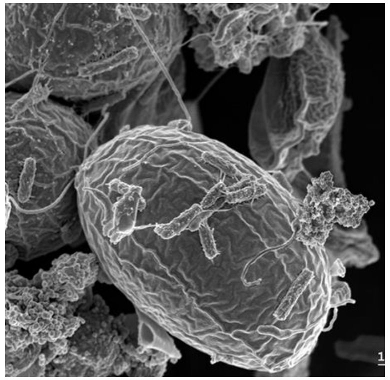
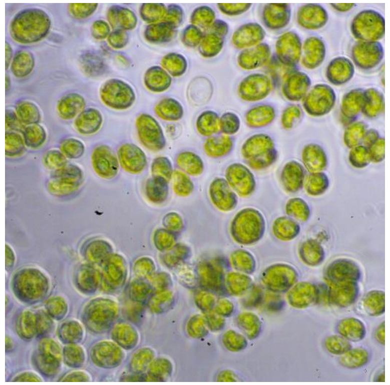


Photo: Universität Hamburg



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Project Results

Assessment of biofilm inhibition potential

- Microalgae microbiomes **inhibit biofilm formation** of fish pathogens to **varying extent**
- Most promising species were further investigated and their DNA and RNA **sequenced**
- Establishment of a metagenome **sequencing pipeline** and **database**

Enzyme testing and antiviral assay

- **Dienelactone hydrolase** protein family was found to be most promising
- **Dlh3** reduced the biofilm formation of fish pathogens up to **54%**
- Development of a **novel antiviral assay** revealed **strong antiviral effects** of some microalgae extracts, biomass, and supernatants

Life cycle assessment

- Development of **ex-ante LCA** model considering **deep uncertainty** of biological systems
- AquaHealth could potentially **reduce environmental impacts** by at least 5%

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Contribution to a Circular Blue Bioeconomy

Zero-waste approach

- **Aquaculture effluents**, wastewater, digestate, and other **side streams** can be used to cultivate microalgae
- Microalgae cultivation media can be **reused**
- **Biorefinery** concepts can be used to recover **multiple products**

Sustainable and renewable

- Potentially **lower environmental impacts** than conventional feed and disease treatment methods
- Microalgal biomass is **renewable** and can be **produced rapidly**
- **Biological** disease treatment method

Carbon cycling

- Efficient **CO_2 sequestration** from industrial sources and the energy sector
- **Carbon utilization** and temporary storage

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Cultivation substrates

- Utilization of **waste streams** or animal by-products is critical for **circularity**
- Regulations **limit** the use of **waste streams/animal by-products**
- Invalidation of **ITMA** schemes

Change of community composition

- **Fluctuations** of microbiome composition in **outdoor** settings
- **Polyculture** often necessary for **bioremediation** of effluents
- Fluctuations in **biomass composition** (standardization is difficult)
- Regulations are **species specific** and **require standards**

Use in functional feed or as a veterinary product

- Application of **specific** microalgae-based **compounds** (e.g. Dlh3)
- **Unclear** which **directives** or regulations apply

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Summary and Outlook

Key findings:

- Microalgae **biomass**, **supernatants**, and **extracts** showed **antimicrobial** and **antiviral** effects against **fish pathogens**
- **Dienelactone hydrolysate** proteins (e.g. **Dlh3**) exhibit significant **biofilm inhibition** effects
- Potential **reduction** of **environmental impacts** from finfish aquaculture by more than **5%**

Outlook:

- **Lifting regulatory barriers** increases **sustainability** and **viability** of microalgal products
- **Less complex** and **harmonized** procedures and standards are suggested
- Stronger **integration of microbiomes** in microalgae research
- Possible **reduction of antibiotics** use
- Establishment of a **sequenceing database** and novel **anti-viral assay**

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