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Impact of cultivation depth on lipids in blue mussels from Kiel fjord

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Introduction

- **Project**: "MyBioFac-Mytilus as a sustainable biofactory" explores the complex bioorganism blue mussel (*Mytilus edulis trossulus* complex) as a sustainable and ecofriendly resource for tailored compounds with high potential for valorization in food and non-food sectors.
- **Background**: The metabolism and, thus, the biochemical composition of mussels is affected by genotype, seasons, age and farming parameters such as depth of cultivation. Mussel lipids consist mainly of poly unsaturated fatty acids (PUFAs). Since mussels undergo homeoviscous adaptation, changing the cultivation depth, i.e., the hydrostatic pressure would influence the membrane lipid biosynthesis.
- **Research question:** Does the cultivation depth influence the lipid content and profile in blue mussels?

Fig 1: Blue mussels (Mytilus edulis trossulus complex)

Fig 2: Internal structure of a blue mussel

Materials & Methods

Fig 3: Harvested mussels from Long line farm

Fig 4: Cultivation on mussel rops (depth: 3,6 and 9 m) at the Kiel marine farm

- **Mussel cultivation:**
  - Blue mussels were cultivated in April and harvested in October 2022
  - Kiel fjord (Baltic sea)
  - Long line cultiviation as a sustainable system
  - Cultivation depths (3, 6, and 9 m) were tested.
  - Salinity: 14.7-15.5 psu; Temperature: 11.2-11.6 °C
- **Sample preparation:**
  - Mussels were frozen at -20°C after harvest until analysed.
  - Mussels were defrosted and manually deshelled.
  - Collected mussel meat was mashed and freeze dried.
- **Lipid extraction** (n=3)**:**
  - Freeze dried mussel meat was used for lipid extraction using two different solvent mixtures by means of ultrasonic rod.
  - Hexane:Isopropanol (IPA) +NaCl or Ethyl acetate (ESTP):IPA + NaCl.
- **Analysis** (n=3)**:**
  - Lipid content was determined gravimetrically.
  - Fatty acid profile was analyzed using gas chromatography.

Results & Discussion

Effect of cultivation depth on the total lipid content in blue mussels

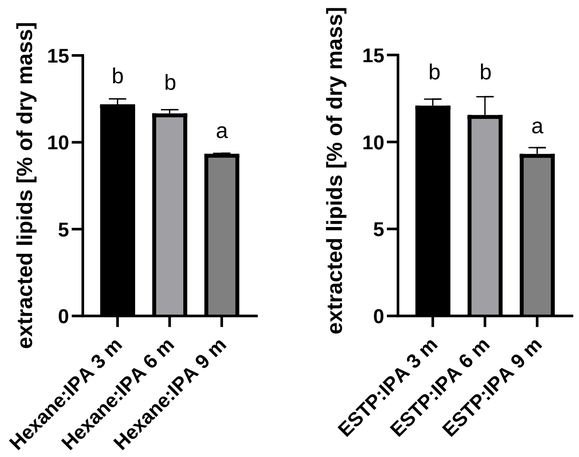

Fig 5: Extraction yield of lipids depending on the solvent and cultivation depth (IPA: Isopropanol, ESTP: Ethyl acetate)

- Significantly less lipids were extracted at 9 m (9.3 ±0.2% of dry mass) cultivation depth than at 3 and 6 m (11.9 ±0.6% of dry mass).
- Slightly less lipids were extracted at 6 m cultivation depth than at 3 m.
- Mussels grown at 9 m were considerably smaller than those at other depths.

Fig 6: The size of blue mussels grown at different depths (from left to right: 3, 6 and 9m)

Effect of cultivation depth on the fatty acid profile of blue mussels

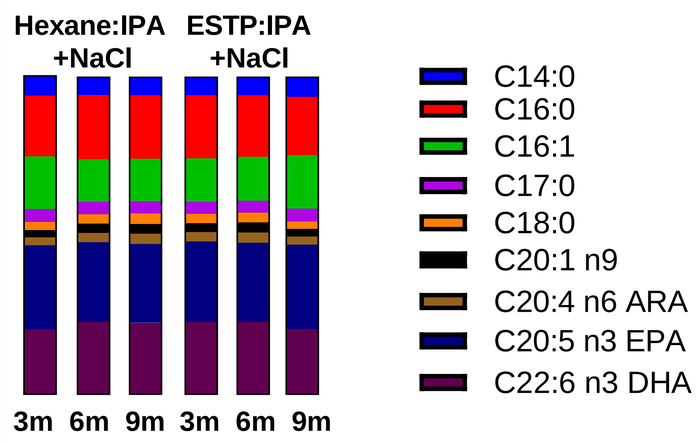

Fig 7: Fatty Acid profile (main fatty acids) in blue mussel depending on the cultivation depth (IPA: Isopropanol, ESTP: Ethyl acetate, ARA:Arachidonic acid, DHA:Docosahexaenoic acid, EPA:Eicosapentaenoic acid)

- **EPA** (23%) was the dominant fatty acid in the mussel meat
- Followed by
  - DHA (19%),
  - Palmitic acid (17 %) and
  - Palmitoleic acid (13 %).
- No clear differences between the used solvent mixtures

Effect of cultivation depth on the content of individual fatty acids in blue mussels

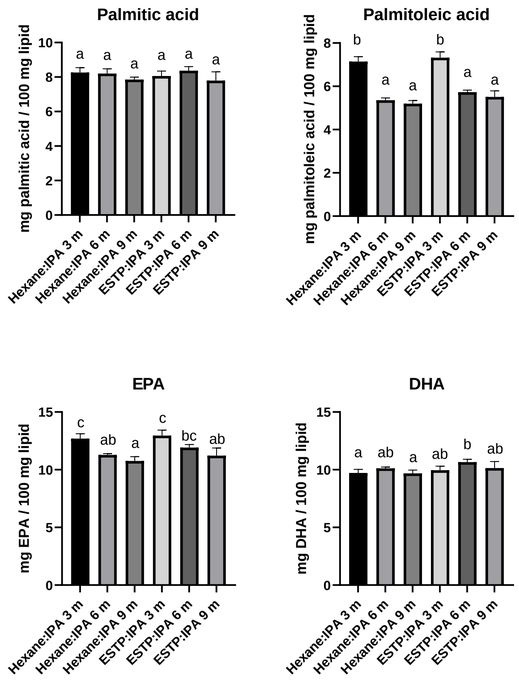

Fig 8: Concentration of selected fatty acids in blue mussel depending on the cultivation depth

- No difference at palmitic acid
- Palmitoleic acid had the highest concentration in 3 m mussels
- The EPA content was highest at 3 m cultivation depth.
- DHA was the highest at 6 m, but this depended on the solvent.

Conclusions

- Mussels from 3 m depth were the largest and contained the highest total lipids and the highest EPA content.
- The cultivation depth of 3 m is therefore the most appropriate when the focus is on lipid content and profile.
- Inconsistent results compared to other studies are conditioned upon several factors such as region, environmental impact, salinity, plankton composition and distribution as well as genotype.
- Further research is currently conducted to find out whether effects of the cultivation depth are constant throughout the year(s).
- Optimizing the cultivation conditions, including depth, in terms of increasing the total lipid and PUFAs content in blue mussels is of great interest for using as an alternative resource to fish oil in food and nutraceuticals, with regard to overexploited fish stocks.

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