

Cod Farming in the Nordic Countries
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Impact of probiotic intervention on microbial load, development and performance of farmed Atlantic cod

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Why probiotics in cod rearing?



To remedy survival problems at early rearing stages by providing an alternative method to enhance fish performance

Selection of two potential probiotic bacteria from cod larviculture

- *Arthrobacter bergerei* from rearing water
- *Enterococcus thailandicus* from algal concentrate

Based on several criteria:

In vitro testing

- competitive exclusion
- metabolite production
- hemolytic activity
- strain identification
- growth characteristics
- adhesion capacity

Application via rearing water at pre- and posthatch stage

- increased larval survival
- increased growth (19.3%)
- increased tolerance
- microbiota control
- presence of both probionts

Larviculture: pre-hatch to 36 dph

- Combined application via rearing water (-3,-1, 1, 4, 8, 14, 21, 28 dph)
- Microbial analysis of rearing water and larval gut
- Larval development (immunological proteins, proteolytic activity)
- Larval survival and growth (dry weight and length)

Juvenile rearing (10-g fish): 28- and 55-day feeding trials

- Two-day acclimatisation period at 7.5°C (80 fish tank⁻¹)
- Combined and separate application via dry feed (10⁷⁻⁹ g⁻¹)
 - Feed types: A (mixed), B (*Arthrobacter*), C (*Enterococcus*)
- Juvenile specific growth rate (SGR)
- Survival, feed conversion ratio (FCR)
- Microbial analysis of rearing water, juvenile gills and gut wall

Main conclusions



- Possible to stimulate cod development, growth and viability as well as to control the microbiota by regular addition of these probiotic bacteria via the rearing water or dry feed.
- Probiotic diet at juvenile stage is profitable, especially under non-optimal conditions.
- Probiotic intervention may shorten in-house juvenile growing time, enhance health and lead to better feed utilisation; **the basis for sustainable cod farming.**
- More research on application dose and long-term effects

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