EPIFISH
Innovative Epigenetic Markers for Fish Domestication

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✓ Fish growth and muscle development
✓ Fish immunology
✓ Epigenetics and miRNAs
Innovative Epigenetic Markers for Fish Domestication

ERC Consolidator grant
2,000,000 EUR
2016-2021

“OK, this domestication thing has gone too far!”
“The ERC's mission is to encourage the highest quality research in Europe through competitive funding and to support investigator-driven frontier research across all fields, on the basis of scientific excellence”
Fish domestication and selective breeding are critical for sustainable aquaculture

Large phenotypic differences in body size after just a few generations of selection

Huge gain for the aquaculture industry but... only ~ 10% of farmed fish have been domesticated thus far

Recometa-Veasco & Ponzoni (2010). FAO
Hypothesis: epigenetics plays a key role in fish domestication

Rapid pace of phenotypic change

Selection is strongly affected by environmental conditions

Limitations of genetic markers to detect selection during domestication
Inheritance of traits and changes in gene expression without changes in DNA sequence

Differences in epigenetic “punctuation” marks in genes with the same DNA sequence determine when and how they are turned on, resulting in very different outcomes
Epigenetics

LET'S EAT GRANDMA

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Epigenetic mechanisms

Environmental factors

Phenotype

Lovrečić et al. (2013) inTech

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Multidisciplinary approach to determine the role of epigenetics in growth improvement during Nile tilapia domestication

WP1 Domestication

WP2 Transcriptomics (mRNA/ miRNA)

WP3 Epigenomics (DNA methylation)

WP4 Functional characterization

WP5 Validation of epimarkers

Dissemination activities

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Basic facts about Nile tilapia (*Oreochromis niloticus*)

- Nile tilapia is a mouthbrooder cichlid that is native to rivers and lakes of Africa and Middle East
- Grows fast and up to > 4 kg
- Tolerates a wide range of environmental conditions
- Feeds mainly on phytoplankton and benthic algae
Nile tilapia is a major aquaculture species

✓ Nile tilapia is the second most important farmed fish worldwide
✓ Vertical integration in the industry
✓ Short generation time (5 months)
✓ Genome assembly available

Annual production (10^3 tonnes)
Multidisciplinary approach to determine the role of epigenetics in growth improvement during Nile tilapia domestication

WP1 Domestication

WP2 Transcriptomics (mRNA/ miRNA)

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Dissemination activities

Project management

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WP1. Domestication of wild Nile tilapia

Main task: Collection of wild fish, establishment of a composite base population $F_0$ and selection for improved growth during domestication for three generations
Wild eggs were collected from Egypt and transferred to Mørkvedbukta.
Comparison of hydroxymethylation profiles in muscle from wild and F0 tilapia

Selected
Control

5 months old
Sexually mature
Same cohort
There were differences in 5mC/5hmC levels between size groups and sex

Potential epigenetic markers of growth
Challenges and future perspectives

Epigenetics in aquaculture is still in its infancy

Technical issues
Complex inheritance?
Stability?

Enormous potential to improve profitability and sustainability of the aquaculture sector

Development of novel genome-wide epigenetic markers
More efficient selection of robust fish (disease resistant, growth, ...)
Tusen Takk!