UPDATE ON AQUACULTURE MICROBIOME RESEARCH

Jake Bledsoe
AQUACULTURE’S BIGGEST CHALLENGES

- **Disease**
  - Antibiotics
    - Resistance, environ. and consumer concerns, Withdrawal periods, $$$
  - Vaccines – development time and $$$$$
  - More treatments/interventions needed!!

- **Nutrition**
  - Economic and environmental sustainability of FM
  - Alternative ingredients
    - Antinutritional factors
  - Need a means to improve intestinal health and dysbiosis → ???
Microbiome-Based Solutions

Early studies suggested microbes were of little physiological relevance in fish, current techniques suggest otherwise.

Microbiome – the collective genetic material or metabolic capacity of microorganisms from a particular environment.

Microbiota – microorganism(s) that inhabit a host-associated habitat.
PHYSIOLOGICAL ROLE OF HEALTHY FISH MICROBIOTA

FISH IMMUNITY AND DISEASE RESISTANCE

1. Required for proper development
2. Maintain active immunity
3. Outcompete pathogens for resources
4. Antimicrobial activities

Kelly & Salinas 2017
Salinas and Parra 2015
Merrifield and Rodiles 2015
PHYSIOLOGICAL ROLE OF HEALTHY FISH MICROBIOTA

GROWTH PERFORMANCE AND DIGESTION

- Provide host with alternative enzymatic pathways
- Influence host metabolism/behavior
- Increase fat digestion
- Production of SCFAs
- Vitamin production
**END-GOAL: TARGETED MICROBIOME MANIPULATIONS**

-Probiotics

-Live microorganisms that confer a health benefit on the host

-Prebiotics

-”Synergistic combination of pre- and probiotic nutritional supplements”

-Synbiotics

-Predictions

-”nondigestible ingredients that stimulating the growth and activity of beneficial microbes”
FACTORS INFLUENCING FISH MICROBIOTA – UNKNOWN??

**INTRINSIC**
- Fish genetics (i.e. species/strain)
- Fish age/development
- Body site
- Disease status

**EXTRINSIC**
- Diet and feeding
- Environ. microbes
- Environ. conditions (i.e. antibiotics, salinity, temp., etc.)
- Stressors (i.e. crowding/transport)

Parra et al. 2015
ONTOGENETIC STUDIES - ONGOING

EFFECTS OF HOST DEVELOPMENT ON THE FISH GUT MICROBIOME

0 dph  20 dph  75 dph

Host-microbiota interactions through time

Stop by the poster for more information!!
DISEASE STUDIES - ONGOING

EFFECTS OF VIRAL AND BACTERIAL PATHOGENS ON FISH MICROBIOME

Stop by the poster for more information!!

**F. psychrophilum**

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<tr>
<th>Fish Strain</th>
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<th>TL</th>
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<td>Cumulative mortalities</td>
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<th>Days Post Challenge</th>
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Log-rank: p < 0.0001

**IHN-V**

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Log-rank: p = 0.48
TOPOGRAPHICAL STUDIES - ONGOING

MICROBIAL ECOLOGY & MUCOSAL IMMUNITY ACROSS BODY SITES

Skin Microbiome

Gill Microbiome

Gut Microbiome

United States Department of Agriculture
Agricultural Research Service
National Cold Water Marine Aquaculture Center
NUTRITIONAL INGREDIENT STUDIES

EFFECTS OF PLANT-BASED DIETS ON THE FISH GUT MICROBIOME – In Prep

Relative Abundance

Genus

Acetanaerobacterium
Aeromonas
Anaerobacillus
Bacillus
Buttiauxella
Carnobacterium
Citrobacter
Clostridium_sensu_stricto_1
Cutibacterium
Delftia
Hafnia–Obesumbacterium
Herbaspirillum
Kluyvera
Kocuria
Lactococcus
Lelliottia
Leuconostoc
Massilia
Mesorhizobium
Microbacterium
Mycoplasma
Ochrobactrum
Peptostreptococcus
Plesiomonas
Ralstonia
Rhodococcus
Romboutsia
Shewanella
Streptococcus
Turicibacter
NUTRITIONAL INGREDIENT STUDIES

EFFECTS OF ALTERNATIVE INGREDIENTS ON THE FISH GUT MICROBIOME – In Prep

Fish Gut Microbiota
Phylum Level Taxonomy

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Tank Averages (n=5)

Abundance

Gut Microbiota Richness

Observed ASVs

Dietary Treatment


Gut Microbiota

OHIO SOYBEAN COUNCIL

ENZO MEAL
COMMERCIAL SCALE STUDIES - ONGOING
FARM WIDE MICROBIOME CHARACTERIZATION

Serial Use Microbiome Samples
• Raceway walls and floor
• Fish gill, gut, & skin
• Feed
• Water

• Multiple farms in the Hagerman Valley
• WQ data gathered for 24h prior to sampling