



# Catfish Aquaculture - Case studies

Using Standard BioTools Microfluidic Technology

Standard BioTools™  
March 2023

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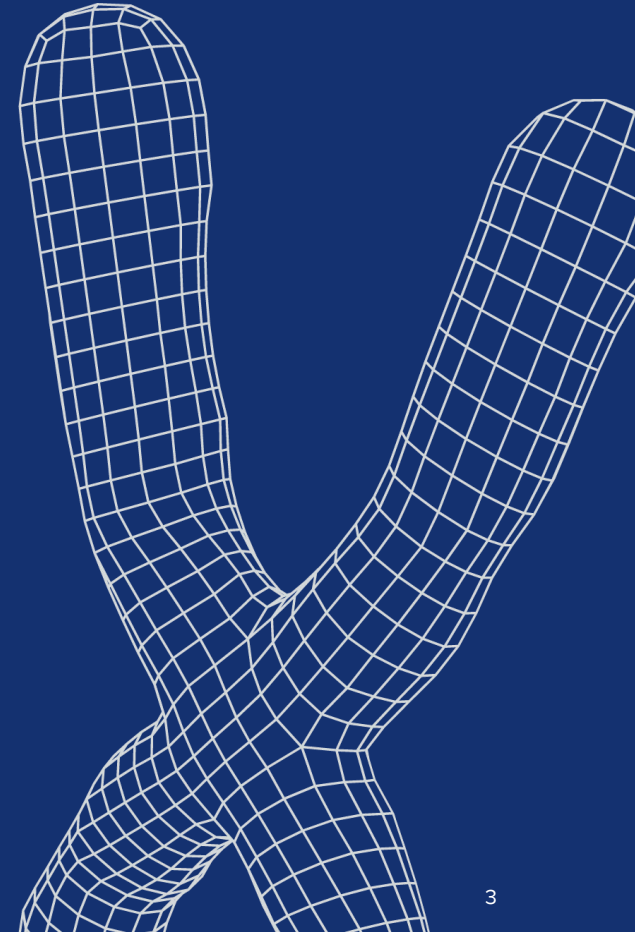




# Gene Expression and Growth

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# Gene Expression and Growth



**Objective:** The objective of this study was to develop and validate a high throughput, microfluidic array for assessing changes in gene expression associated with channel catfish appetite, growth, metabolism, and intestinal health, while also providing a cost effective, dynamic, gene expression platform for use with other cultured fishes.

### Utilization of Standard BioTools products:

- Biomark HD System
- MX Controller
- 48.48 dynamic arrays

### Conclusions:

- Developed and validated Channel Catfish gene expression panel.
- Provide reliable cycle threshold levels, amplification efficiency, and quality threshold scores.
- Demonstrated benefits of Standard BioTools microfluidics high throughput qPCR method over conventional qPCR.
- Array paves the way for rapid evaluation of feeding strategies, dietary formulations, supplementation, and environmental and management effects for improving channel catfish culture.

Schroeter, et al. "Development of a multitissue microfluidic array for assessing changes in gene expression associated with channel catfish appetite, growth, metabolism, and intestinal health". *Aquaculture* (2016)

# Gene Expression and Growth

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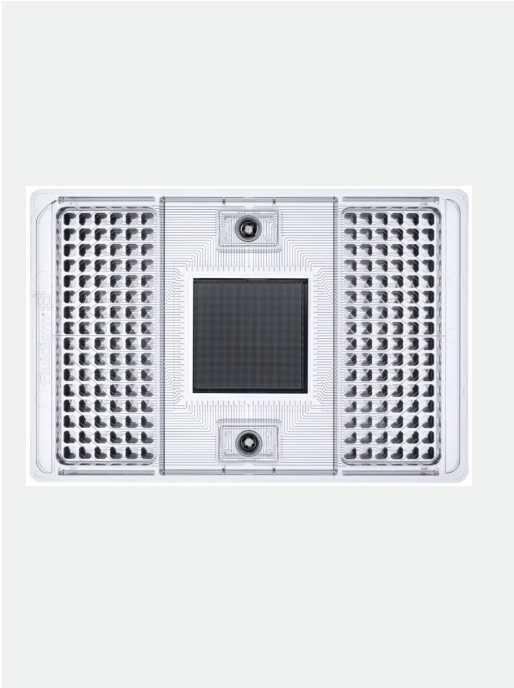


## Background

- At the time of publication, channel catfish represented the USA's largest finfish aquaculture industry.
- A fast, cost-effective, easy method for affecting production parameters in channel catfish did not exist.
- The authors developed and validated a panel to assess channel catfish appetite, growth, metabolism, and inflammatory response.

[Schroeter, et al. "Development of a multitissue microfluidic array for assessing changes in gene expression associated with channel catfish appetite, growth, metabolism, and intestinal health". Aquaculture \(2016\)](#)

# Gene Expression and Growth



## Background

- Data collected using the 48.48 GE IFC on the Biomark HD.
- Established primer amplification efficiency, quality scores, and cycle threshold using Standard BioTools Real-Time PCR Analysis software.
- Delta Gene assays (Standard BioTools) used to create 48 gene target panel including genes related to the following categories:
  - Appetite
  - Growth
  - Metabolism
  - Inflammatory response

**NOTE:** Paper was published before channel catfish genome published. A high-quality channel catfish genome is now available.

[Schroeter, et al. "Development of a multitissue microfluidic array for assessing changes in gene expression associated with channel catfish appetite, growth, metabolism, and intestinal health". Aquaculture \(2016\)](#)

# Gene Expression and Growth

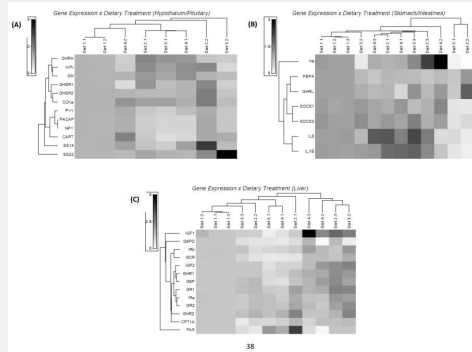
## Results and conclusions

### Results:

- 48 assays designed and validated.
- 8 assays did not meet performance metrics and were removed.
- Alpha Tubulin selected as most appropriate reference gene.
- Tissues from catfish fed four diets were collected and run on a single 48.48 GE IFC to demonstrate the ease of use and cost savings of the microfluidic platform.

### Conclusions:

- Using the Standard BioTools IFC to assess catfish production metrics demonstrates a fast, cost-effective solution over traditional qPCR and sequencing methods.
- Standard BioTools IFC offerings allow the quick change of assay design based on study needs and sample throughput.



Schroeter, et al. "Development of a multitissue microfluidic array for assessing changes in gene expression associated with channel catfish appetite, growth, metabolism, and intestinal health". *Aquaculture* (2016)



# Gene Expression and Stress Response

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# Gene Expression and Stress Response

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**Objective:** Observe and report growth performance and welfare of African catfish throughout a growth period in commercial production environment.

## Utilization of Standard BioTools products:

- Biomark HD System
- 48.48 dynamic arrays

## Conclusions:

- Semi-intensively stocked fish have significantly higher weights than other groups.
- Semi-intensive stocking reduces aggression and skin lesions.
- Identified novel genes used as markers of stress response in catfish.



### Article Effects of Stocking Density, Size, and External Stress on Growth and Welfare of African Catfish (*Clarias gariepinus* Burchell, 1822) in a Commercial RAS

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**Abstract:** The effects of semi-intensive (100 kg m<sup>-2</sup>), intensive (200 kg m<sup>-2</sup>), and super-intensive (400 kg m<sup>-2</sup>) stocking densities on the growth and welfare of African catfish (*Clarias gariepinus*) were investigated under commercial production conditions. Plasma cortisol, glucose, and selected transcripts following a stress challenge, lactate, as well as skin lesions, were analyzed at regular intervals (from 12 g juveniles to 1.5–2.0 kg). The fish grew well, but after 20 weeks, the semi-intensively stocked fish had a mean final weight of 1838.5 g, significantly higher than the super-intensively stocked fish with 1615.4 g, and considerably higher than the intensively stocked fish with 1044.6 g ( $p < 0.05$ ). Cortisol and glucose responses significantly differed between stressed and unstressed fish, but not between treatment groups. An unforeseen external stressor (nearby demoltion noise) caused stress responses among all treatment groups, but was similarly coped with. Mortality ranged between 3.8–9.2%. In the juveniles, skin lesions were reduced under intensive or super-intensive densities, with the least under semi-intensive densities in outgrown fish. Expression profiles of 22 genes were compared in the spleen at semi-intensive and super-intensive densities. The transcript concentrations of most genes remained unchanged, except for *clh3af* and *mtf1*, which were significantly downregulated in stressed catfish under semi-intensive conditions. We demonstrated that African catfish growth performance and welfare depend on age and stocking density, also reacting to demoltion noise. This supports farm management to optimize stocking densities during the grow-out of African catfish in RAS and suggests avoiding external stress.

**Keywords:** cortisol; demoltion noise; fish well-being; grading; growth performance; recirculating aquaculture; mortality

#### 1. Introduction

In finfish aquaculture, stocking density is a pivotal factor and an issue of frequent debate, as it may be a source of chronic stress, leading to physiological alterations, including stress responses, growth reduction, and impairment of health [1–3]. Based on these indicators, fish welfare can be considered diminished [2,4–7]. According to Ellis et al. [2] (p. 494), “... the term ‘stocking density’ refers to the concentration at which fish are initially stocked into a system” (semi-intens). However, most often, the term is used to describe the density of fish at any time. It may thus be understood as a dynamic factor, since the actual density increases or decreases as the fish grow or are removed from the rearing volume. Fish species in aquaculture are stocked at very different densities, typically ranging from < 10 to 100 kg m<sup>-2</sup> [4,5]. This widely varies due to the different needs and/or tolerances of

Fishes 2023, 8, 74. <https://doi.org/10.3390/fishes802074>

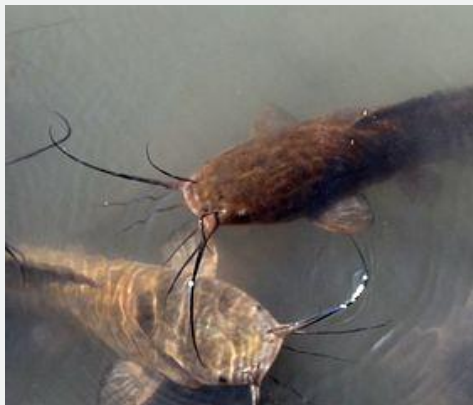
<https://www.mdpi.com/journal/fishes>

Baßmann, et al. “Effects of Stocking Density, Size, and External Stress on Growth and Welfare of African Catfish (*Clarias gariepinus* Burchell, 1822) in a Commercial RAS”. *Fishes* (2023)

# Gene Expression and Stress Response

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## Background:

- In finfish aquaculture, stocking density is a pivotal factor and an issue of frequent debate, as it may be a source of chronic stress, leading to physiological alterations, including stress responses, growth reduction, and impairment of health. Collectively this can be termed fish welfare.
- The authors wanted to test the effects of stocking density on the welfare of African catfish in a commercial setting.
- Authors tested three levels of stocking density and observed fish growth performance, mortality, cortisol levels, skin lesions and gene expression due to different stressors.

Baßmann, et al. "Effects of Stocking Density, Size, and External Stress on Growth and Welfare of African Catfish (*Clarias gariepinus* Burchell, 1822) in a Commercial RAS". *Fishes* (2023)

# Gene Expression and Stress Response

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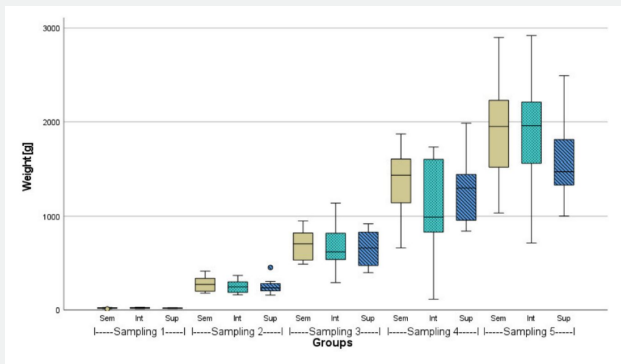
## Results and conclusions

### Results:

- Growth rate of catfish is high at all densities.
- Semi-intensive density results in higher growth with lower aggression.
- Fish welfare decreased at super-intensive densities in general but in all groups due to nearby construction noise.

### Conclusions:

- Adjustments to stocking density during growth phase to semi-intensive.
- Limit external stressors.
- Can monitor stress response molecularly.



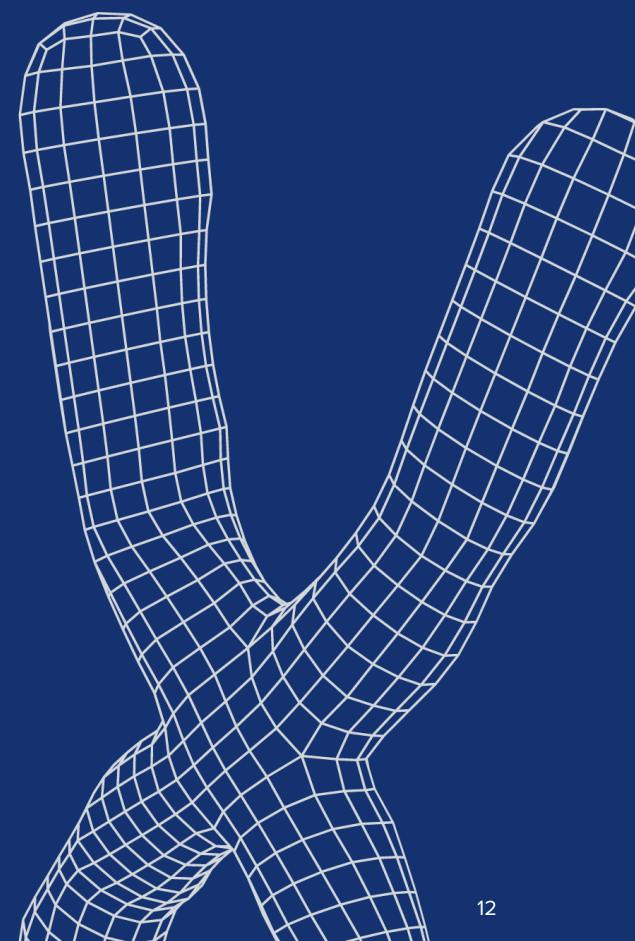
Baßmann, et al. "Effects of Stocking Density, Size, and External Stress on Growth and Welfare of African Catfish (*Clarias gariepinus* Burchell, 1822) in a Commercial RAS". *Fishes* (2023)



# Gene Expression and Diet

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# Gene Expression and Diet

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**Objective:** Determine the effects of alternatively-sourced dietary ingredients of production indices, gut health, changes in gut microbiota and genes involved in appetite regulation, growth, metabolism, and intestinal inflammation.

## Utilization of Standard BioTools products:

- Biomark HD System
- 48.48 GE dynamic arrays
- Access Array
- 48.48 LP dynamic arrays

## Conclusions:

- Feed conversion rate was affected by diet.
- The gene expression panel used can help determine mechanisms behind FCR change and predict longer term effects of different diets than this study allowed.
- Gut microbiome data can be used to influence future dietary studies.

[Schroeter, et al. "Targeted gene expression panels and microbiota analysis provide insight into the effects of alternative production diet formulations on channel catfish nutritional physiology". Aquaculture \(2018\)](#)

# Gene Expression and Diet

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## Background:

- Culturing channel catfish requires nutritionally complete diets for maximal growth and feed efficiency.
- Due to cost and availability, alternative feeds have been produced.
- Many components of alternative feeds introduce high fiber content and anti-nutritional factors which can reduce nutrient uptake and negatively affect production indexes.
- Monitoring gene expression and gut microbiota can show how anti-nutritional factors affect fish health and growth.

[Schroeter, et al. "Targeted gene expression panels and microbiota analysis provide insight into the effects of alternative production diet formulations on channel catfish nutritional physiology". Aquaculture \(2018\)](#)

# Gene Expression and Diet

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## Methods:

Catfish were fed four different diets similar to diets in common feeds.

## Gene Expression:

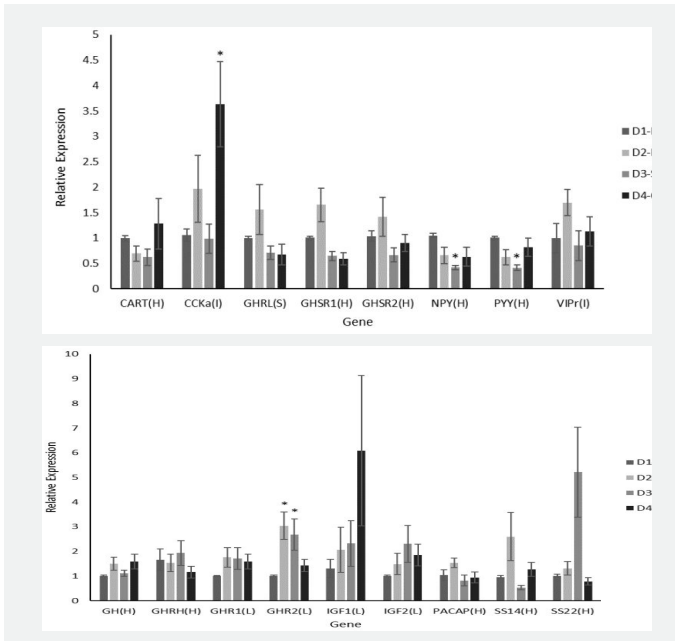
- RNA extracted from multiple tissues.
- 40 gene target panel used to observe appetite, growth, metabolism, and inflammatory response.
- Data collected on Biomark HD using 48.48 GE IFC.

## Library Prep:

- RNA extracted from whole intestines.
- Standard BioTools Access Array system used to create 16s rRNA library for sequencing.

[Schroeter, et al. "Targeted gene expression panels and microbiota analysis provide insight into the effects of alternative production diet formulations on channel catfish nutritional physiology". Aquaculture \(2018\)](#)

# Gene Expression and Diet



## Results and conclusions

### Results:

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### Conclusions:

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Schroeter, et al. "Targeted gene expression panels and microbiota analysis provide insight into the effects of alternative production diet formulations on channel catfish nutritional physiology". *Aquaculture* (2018)



# Modern aquaculture is powered by X9

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[www.standardbiotools.com/x9](http://www.standardbiotools.com/x9)

