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United States Department of Agriculture
Project Initiation

Project Data for Accession Number 1035096

Project Title

Live-Attenuated Vaccine Development and Immunopotentiation Strategies to Control Streptococcosis in U.S. Catfish Aquaculture

Project Details

Sponsoring Institution National Institute of Food and Agriculture	**Project Status** ACTIVE
Funding Source NIFA Non Formula	**Grant Year** 2026
Grant No. 2026-70007-46905	**Cumulative Award Amt.** $304,357.00
Proposal No. 2026-07381	**Multistate No.** (N/A)
Project Start Date Sep 15, 2026	**Project End Date** Sep 14, 2028
Program Code [AQUA] Aquaculture Research	

Project Director

Heckman, T.

Recipient Organization

MISSISSIPPI STATE UNIVERSITY

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Performing Department

(N/A)

Non Technical Summary

Streptococcosis caused by the emerging bacterial pathogen Streptococcus dysgalactiae presents a rapidly growing threat to the profitability and long-term viability of the U.S. catfish aquaculture industry. This bacterial disease primarily impacts channel catfish broodstock during spawning season, causing direct fish losses and poor hatch rates that drastically reduce economic returns and regional fingerling supply. Treatment options are limited, and application of antibiotics in broodstock is restricted by logistic and safety complications. This project will address these issues by delivering complementary tools for proactive disease prevention. Specifically, it will (1) develop live-attenuated S. dysgalactiae vaccine strains optimized for feed-based delivery and (2) evaluate immunostimulant feed additives for improved catfish health and resistance to S. dysgalactiae infection. These approaches were designed with industry input and can be readily integrated into existing catfish farming practices to provide both pathogen-specific protection

and enhanced immune readiness. By delivering practical, producer-focused solutions for fish health management, this project will strengthen domestic aquaculture production, support rural economies, and contribute to a more resilient U. S. food system.

Animal Health Component

Animal Health Component: 100%

Research Effort Categories

Basic	10%
Applied	45%
Developmental	45%

Classification

Knowledge Area (KA)	Subject of Investigation (SOI)	Field of Science (FOS)	Percent
311	3710	1090	50%
311	3710	1100	50%

Knowledge Area

[311] Animal Diseases

Subject Of Investigation

[3710] Catfish

Field Of Science

[1090] Immunology

[1100] Bacteriology

Keywords

Vaccines, aquaculture, catfish, immunostimulants, streptococcus, functional feeds

Goals / Objectives

The major goal of this project is to strengthen the health, productivity, and resilience of U.S. catfish aquaculture by developing practical disease prevention strategies for Streptococcus dysgalactiae, an important emerging bacterial pathogen associated with channel catfish broodstock losses and reduced hatch success. The study objectives supporting this goal are to (1) Develop live-attenuated Streptococcus dysgalactiae vaccine strains optimized for feed-based delivery to channel catfish and (2) Evaluate immunostimulant feed additives for improved catfish health and resistance to S. dysgalactiae.

Project Methods

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This project will evaluate feed-based strategies for prevention of Streptococcus dysgalactiae infections in channel catfish (Ictalurus punctatus). The first objective will develop live-attenuated vaccine candidates from regional strains of the bacteria using an established method of serial laboratory passage and subsequent screening for reduced virulence. A panel of candidate strains from the midpoint and final passages will be assessed for in silico, in vitro, and in vivo indicators of attenuation by whole genome sequencing and comparative analysis, bacterial growth and whole blood survival assays, and infection studies in channel catfish fingerlings. Three candidates that demonstrated significantly reduced virulence will be selected for further development. A backpassage safety study will be conducted to assess risk of reversion to virulence in a susceptible host by injecting, reisolating, and re-administering the bacteria five times, followed by disease monitoring and whole genome sequencing to confirm stable attenuation. The capacity of the candidates to still elicit a protective immune response without causing clinical disease will then be assessed by oral and injection routes. Injectable formulations will be delivered intracelomically under anesthesia. Oral formulations will be delivered as top-coated feed. Both will be formulated to deliver a comparable target dose and will be tested with relevant controls. Subsamples of fish will be collected over the course of the immunization period to quantify antibody response by enzyme-linked immunosorbent assay (ELISA). After 28 days, the remaining fish will be challenged with a virulent, wild-type strain of S. dysgalactiae and monitored for mortality or development of clinical disease for 30 days. All surviving fish will be euthanized for blood and tissue collection to assess final antibody levels and bacterial persistence by culture and qPCR. This objective is expected to yield at least one stably attenuated strain of S. dysgalactiae with consistently reduced virulence metrics that provides significant protection by both injection and oral routes.The second objective will evaluate commercially available phytogenic and yeast-derived immunomodulatory feed additives as practical tools to improve fish health and resistance to disease. Diets will be formulated by mixing the powdered components with a commercial pelleted feed and a vegetable oil binder. The control feed will only be mixed with vegetable oil. The diets will be administered to channel catfish fingerlings for four or eight weeks for yeast-derived or phytogenic compounds, respectively. At the end of the feeding period, growth metrics will be calculated and a subsample of fish collected for lysozyme activity and immune gene expression assays. The remaining fish will be challenged with a virulent wild-type strain of S. dysgalactiae or a sham-control and monitored for disease progression for 30 days. All surviving fish will then be euthanized for bacterial recovery and load quantification. Dietary supplementation with phytogenic and yeast-derived additives is expected to modulate innate immune gene expression and elevate serum lysozyme activity to confer improvements in survival following S. dysgalactiae challenge.