

EVALUATING THE SUPPLEMENTATION OF SOY LECITHIN FOR THE PRODUCTION PERFORMANCE AND PHYSIOLOGICAL RESPONSES OF CHANNEL CATFISH (*ICTALURUS PUNCTATUS*)

Principal Investigator: Fernando Y. Yamamoto, Ph.D., Mississippi State University Department of Wildlife, Fisheries, and Aquaculture
Thad Cochran National Warmwater Aquaculture Center



FUNDED BY CHECKOFF DOLLARS

PURPOSE OF THE STUDY

Dietary lipids are a primary source of energy for fish and supply essential fatty acids needed for growth and health. Soy lecithin (SL), a byproduct of soybean oil refining, is a commonly used source of phospholipids in aquaculture diets. Previous research into Caspian brown trout (*Salmo trutta caspius*) reported improvements in growth, survival, and stress resistance following SL supplementation.

Three feeding trials evaluated the effects of SL on the production performance, physiological resilience, and fillet quality of channel catfish (*Ictalurus punctatus*) and hybrid catfish (*I. punctatus* x *I. furcatus*).

OBJECTIVES

Two indoor feeding trials and a pond trial evaluated supplementation with SL, soybean oil (SBO), and catfish oil (CFO) in catfish diets for:

- Optimal inclusion levels of SL for production performance and physiological responses
- Potential to modulate expression of immune-related genes
- Growth performance, survival, and carcass yield
- Fillet quality

INDOOR STUDY DESIGN

Two separate indoor feeding trials evaluated the effects of adding SL to plant-based diets of channel catfish fingerlings.

INDOOR STUDY DESIGN (CONT.)

TRIAL 1

Five diets were randomly assigned to five replicate aquaria per diet each, with graded levels of SL replacing SBO:

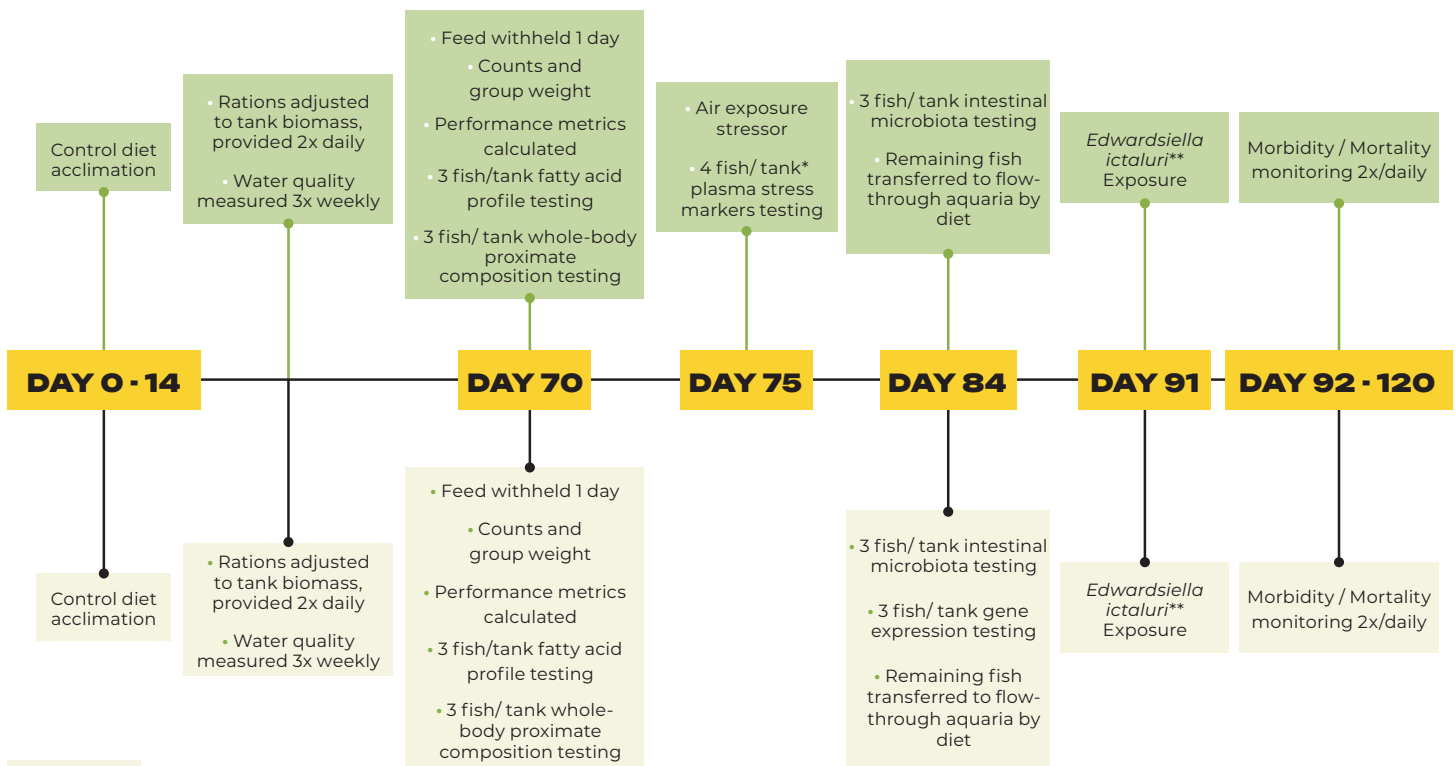
- **Control:** SL 0%; SBO 3.47%
- **Diet 0.5%:** SL 0.5%; SBO 2.97%
- **Diet 1%:** SL 1%; SBO 2.47%
- **Diet 1.5%:** SL 1.5%; SBO 1.97%
- **Diet 2%:** SL 2%; SBO 1.47%

TRIAL 2

Three diets were randomly assigned in equal replication to 18 aquaria, with six aquaria per diet, of 30 fingerlings each. The diets were formulated similarly except for supplemental lipid source:

- **SBO Diet:** SBO 2.45%; SL and catfish oil (CFO) 0%
- **SL Diet:** SBO 1.45%; SL 1%; CFO 0%
- **CFO Diet:** CFO 2.45%; SBO and SL 0%

TRIAL 1



TRIAL 2

* randomly selected at various intervals after each exposure
 ** virulent strain of Enteric Septicemia of Catfish pathogen

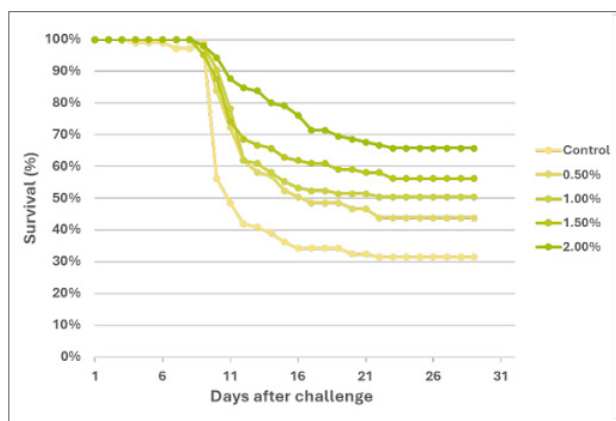
INDOOR RESULTS

Trial 1

Feed efficiency was greater in fish fed 1.5% SL compared to the Control group. Fish fed 0.5% SL were more efficient in converting dietary protein to biomass than the Control group.

Alpha diversity of intestinal microbiota measured with Pielou's evenness was significantly higher (indicating greater microbial evenness) in the 1.5% SL fish than the 0.5% SL group — but the overall treatment effect was marginal among all groups.

In the bacterial challenge, after 22 days the control group had a 35.8% survival rate, significantly lower than the survival of all SL-fed groups. The 0.5% SL diet group's rate was 52.5% and improved with higher SL inclusion: a 59.5% survival rate for the 1% SL group; 60.8% rate for 1.5% SL fish; and 70.8% for 2% SL fish.



Survival curve of Trial 1 channel catfish juveniles fed increasing levels of soy lecithin (Control, 0.5, 1, 1.5, and 2% inclusion diets) exposed to *E. ictaluri* through immersion.

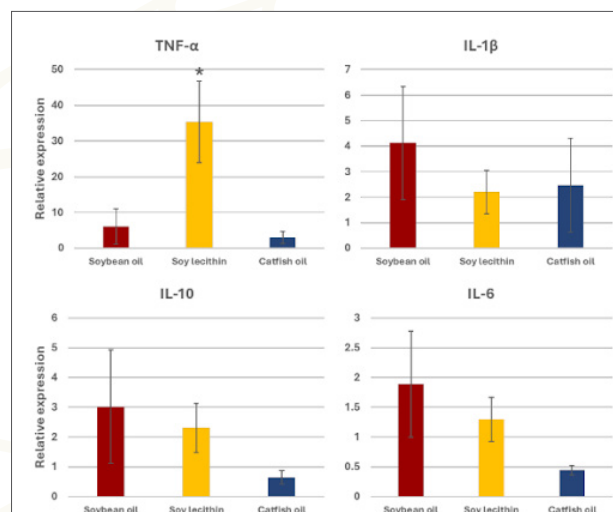
Trial 2

Feed efficiency was significantly greater in the SL diet group compared to the

SBO group. The concentrations of specific fatty acids (positive for fish and human health) were higher in CFO-fed fish compared to the other two groups, except for polyunsaturated fatty acids, which were lower than in the other two groups. Significant differences were observed for TNF- α gene expression, an important regulator of immune and inflammatory responses, in SL-fed fish compared to the other two groups.

Hemoglobin (Hb) levels were significantly greater in CFO-fed fish than in SBO-fed fish — hematological parameters are often used to evaluate general health status. On this point, however, these results conflict with some earlier studies, suggesting Hb effects may be species- or dose-dependent. This finding warrants further research.

Similar to Trial 1, after the bacterial challenge, diet significantly affected survival in the SL group, with a 60% survival rate. The CFO group had a rate of 54.2% and the SBO group, 44.5%.



Gene expression of cytokines in the intestinal tissue of experimental channel catfish after Trial 2. Data are presented as means, with error bars representing standard errors. Expression of genes encoding cytokines was normalized to the reference gene ACTB, encoding β -actin.

OUTDOOR STUDY DESIGN

A third trial evaluated hybrid catfish juveniles receiving one of three treatments:

- With a feed top coated with **1% CFO**
- With a feed top coated with **1% mixture SBO / SL (0.5%/0.5%)**
- Uncoated commercial feed as the control

Thirty earthen ponds were stocked with 1,000 fingerlings each. The three diets were randomly assigned to ponds, with 10 replicate ponds per treatment. Fish were fed to satiation once daily for 119 days, then fasted for two days before being harvested, group-weighted, and counted. A subset of 100 fish per pond were assessed for size distribution based on diet; another 30 per pond were processed for sampling. Remaining fish were euthanized and counted.

OUTDOOR RESULTS

The intraperitoneal (abdominal space) fat ratio was significantly affected by diet, with CFO fish presenting greater intraperitoneal fat accumulation in this cavity compared to the Control group. Significant differences were also observed for different fillet fatty acids, depending on diet.

At the end of the study, diet significantly affected distribution of class sizes of hybrid catfish. Ponds receiving the CFO-coated feed had fewer fish weighing under 0.5 pound, with a higher proportion of fish weighing between 0.75 to 1 pound.

BENEFIT FOR THE SOYBEAN FARMER

➤ These trials demonstrate that supplementing plant-based diets with soy lecithin may impart benefits such as enhancing feed efficiency, influencing gene expression modulating inflammation in immune response, and improving disease resistance and survival rates — particularly in response to enteric pathogens such as *E. ictaluri* — opening additional soy use in aquaculture diets.

➤ Incorporating SL into channel catfish feed has demonstrated the potential to significantly improve production for aquaculture farmers, which could in turn raise demand for soybean-derived lecithin additives.

**SCAN FOR
PROJECT
DETAILS**

