EVALUATION OF SOY INGREDIENTS IN JUVENILE LARGEMOUTH BASS CULTURE

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PURPOSE OF THE STUDY

With the success of integrating soy protein as fishmeal replacement into diets for major aquaculture species such as catfish, tilapia, and rainbow trout, there is interest in extending this to largemouth bass (LMB) to benefit from rising market demand for the fish. This study's purpose was to gain more information on LMB response to soybean process variants as well as optimal feed inclusion rates.

OBJECTIVES

Type and level of soy protein inclusion are integral for optimizing LMB feed rates that benefit industry-relevant growth performance and health. Study objectives included:

- Determining growth performance in LMB fed soy protein
- Characterizing gastrointestinal health following soy feeding
- Discerning changes to columnaris disease susceptibility following feeding with soy process variants

STUDY DESIGN

The initial 14-week growth trial in the summer was conducted on juvenile LMB in 16 tanks, with 50 fish per tank and four replicates per diet, within a recirculation aquaculture system at the E.W. Shell Fisheries Center at Auburn. The four dietary treatments examined were: basal/control (Menhaden FM control) and three test diets including basal-soybean meal (B-SBM); basal-soy protein concentrate (B-SPC); and basal-enzyme-treated soybean meal (B-ESBM). For each test diet 50% of the fishmeal was replaced by various soy sources on an equal protein basis. Over the course of the study the fish were fed to near satiation with a fixed ration based on the biomass of the tank.

Immediately following this trial, the LMB were exposed to a pathogen challenge trial using a virulent isolate of *Flavobacterium columnare*, the causative agent of columnaris disease, administered using bath exposure with prepared inoculum. This pathogen challenge was conducted over six days.

Finally, the team investigated intestinal tract health of the soy-fed LMB to discern any potential signs of inflammation, by looking

at the gene expression profiles of important cytokines and investigating the distal intestines, including the microbiota within them.

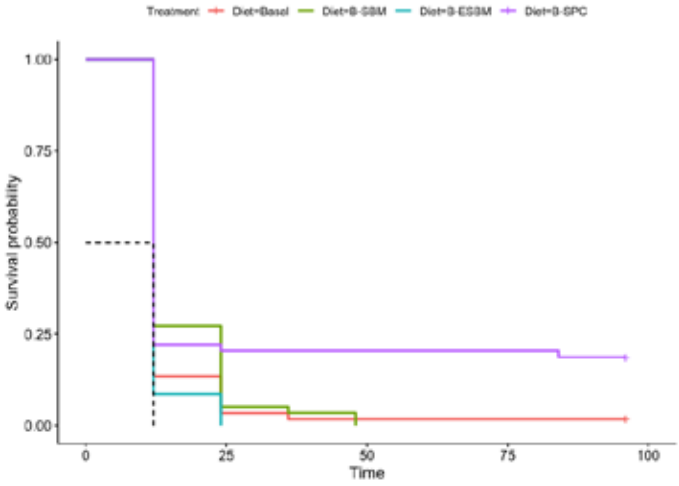
RESULTS

There were overall no differences found in growth among the four diet formulations at the end of the 14-week trial, except in the feed conversion ratio (FCR), which was found to be slightly lower in the Menhaden FM control diet. No major differences were reported in proximate composition of collected whole-body LMB at the end, although treatment diets trended with elevated fat values. Notably, LMB fed B-SBM and B-ESBM diets had reduced serum lysozyme activity, an important immune parameter; creatine levels indicating muscle metabolism were also lower in treatment diets compared to the Menhaden FM control fish.

In investigating the health of the intestinal tract at the end of the trial, the team concluded that the invoked inclusion rate of the soy protein products did not impact tract health, as no major signs of inflammation were present.

Following the pathogen challenge, the team found that cumulative mortality was not statistically different among the dietary treatment-fed LMB along the Kaplan-Meier log-rank curve, though highest survival was logged for those fed the B-SPC diet, followed by those on the Menhaden FM control diet. Additionally, researchers found that mortalities peaked at 12 hours post-infection period.

- Slight differences between control and soybean diets
- Soy diets resulted in higher fat values
- No impact on intestinal health
- No statistical difference in mortality with pathogen challenge



Kaplan-Meier log-rank survival curve of dietary treatment-fed largemouth bass exposed to an in vivo immersion-based infection challenge with ***F. columnare*** strain.

ADDITIONAL STUDY OBJECTIVE

Following the 14-week study, the team conducted an additional six-week LMB study in glass aquariums, which consisted of replacing a solvent-extraced soybean meal with either a low-oligosaccharide soybean meal (LSBM) or an enzyme-treated soymeal (ESBM) in gradient thresholds of 40, 60, 80, and 100% for a total of nine treatments (including the control SBM diet). The fingerlings were fed twice daily at a restricted 5.5% tank biomass rate. The 60% and 100% ESBM diets performed better in these cases than the SBM diet.

Growth performance of juvenile largemouth bass (initial mean weight 8.55±0.18g) for the six-week growth trial. Low-oligosaccharide soybean meal (LSBM) or an enzyme-treated soybean meal (ESBM).

Treatments	Mean weight (g)	Weight gain (g)	Weight gain (%)	FCR	TGC	ANPR (%)	Survival (%)
SBM	22.05^{b}	13.61^{b}	161.52	1.53^{b}	0.39^{b}	26.02^{ab}	98.8
LSBM 40%	26.20^{ab}	17.76^{ab}	211.50	1.26^{ab}	0.51^{ab}	33.27^{ab}	98.3
LSBM 60%	25.92^{ab}	17.68^{ab}	214.89	1.24^{ab}	0.51^{ab}	33.58^{ab}	98.3
LSBM 80%	27.16^{ab}	18.32^{ab}	208.48	1.27^{ab}	0.53^{ab}	31.51^{ab}	93.3
LSBM 100%	24.87^{ab}	16.37^{ab}	192.77	1.32^{ab}	0.49^{ab}	30.65^{ab}	94.4
ESBM 40%	26.23^{ab}	17.78^{ab}	212.12	1.28^{ab}	0.51^{ab}	34.50^{a}	96.6
ESBM 60%	28.31^{a}	19.64^{a}	226.77	1.14^{a}	0.57^{a}	35.16^{a}	93.3
ESBM 80%	26.83^{ab}	18.13^{ab}	208.40	1.27^{ab}	0.52^{ab}	33.18^{ab}	98.3
ESBM 100%	28.01^{a}	19.31^{a}	221.53	1.18^{ab}	0.56^{a}	38.51^{a}	93.3
PSE	1.21	1.21	15.153	0.08	0.03	1.94	2.3
p-value	0.017	0.026	0.089	0.035	0.022	0.0012	0.367

Weight gain (g) = Final Mean Weight (g)- Initial Mean Weight (g)
Weight gain (%) = [(Final Mean Weight(g) – Initial Mean Weight(g))/ Initial Mean Weight(g)] *100
FCR (Feed conversion ration)=Total dry feed weight (g) / (Final Mean Weight- Initial Mean Weight) (g)
ANPR (Apparent Net Protein Retention)
TGC (Thermal-unit growth coefficient)
Survival (%) = (Final total fish number / Initial total fish number) *100

BENEFIT FOR THE SOYBEAN FARMER

- No major differences in growth or mortality were found in LMB when 50% of fishmeal in their diet was replaced with the various soybean protein sources — indicating there is considerable potential for soybean inclusion in commercial formulations.
- Using soy protein in domestic aquaculture allows producers to decrease operational costs while retaining growth performance, which also provides soybean growers an additional long-term revenue stream.

SCAN ME

VIEW THE PROJECT OVERVIEW