OMB Control No. 0648-0362
Expiration Date 3/31/2008

SEA GRANT PROJECT SUMMARY FORM 90-2
DEVELOPMENT PROPOSAL

(1) INSTITUTION: Southern Illinois University Carbondale
(1a) ICODE:
(2) TITLE: REPLACEMENT OF FISH MEAL IN HYBRID STRIPED BASS DIETS WITH PROTEINACEOUS FERMENTATION BIOMASS

(3) PROJECT NUMBER:
(4) REVISION DATE:
(5) PROJECT STATUS:
(6) INITIATION DATE:
(7) COMPLETION DATE:
(8) SUB PROGRAM:

(9) PRINCIPAL INVESTIGATOR: Jesse Trushenski
(9a) EFFORT: 1% (0.12 person months)
(9b) AFFILIATION: Southern Illinois University Carbondale, Fisheries and Illinois Aquaculture Center
(9c) AFFILIATION CODE:

(10) CO-PRINCIPAL INVESTIGATOR:
(10a) EFFORT:
(10b) AFFILIATION:
(10c) AFFILIATION CODE:

(11) ASSOCIATE INVESTIGATOR 1: Brian Gause (graduate student)
(11a) EFFORT: 50% (6 person months)
(11b) AFFILIATION: Southern Illinois University Carbondale, Fisheries and Illinois Aquaculture Center
(11c) AFFILIATION CODE:

(12) ASSOCIATE INVESTIGATOR 2:
(12a) EFFORT:
(12b) AFFILIATION:
(12c) AFFILIATION CODE:

(13) S.G. FUNDS:
(14) STATE MATCHING FUNDS:
(15) LAST YEAR'S SG FUNDS:
(16) LAST YEAR'S MATCHING FUNDS:
(17) PASS-THROUGH FUNDS:
(18) LAST YEAR'S PASS-THROUGH FUNDS:
(19) RELATED PROJECTS:
(20) PARENT PROJECTS:
(21) SEA GRANT STRATEGIC PLAN CLASSIFICATION:

(22) OBJECTIVES:

To determine the extent to which yeast-based proteinaceous fermentation biomass (PFB, co-product of the bioethanol production) can replace capture fishery-derived protein in aquaculture feeds.

(23) PROBLEM:

The demand for seafood, both marine and freshwater, is on the rise in the United States. While much of the seafood supply is still captured in the wild, aquaculture is contributing to a larger portion of the supply each year. In the United States, seafood demand is primarily focused on high value, carnivorous species. Accordingly, U.S. aquaculture emphasizes intensive culture of high value, carnivorous species. An example of one such fish is hybrid striped bass, which are widely cultured as sportfish and foodfish, particularly in Indiana and Illinois. Both states have undertaken extensive stocking programs of HSB as a sportfish because of their popularity with fishermen. In Illinois, HSB have been the #1 cultured fish for the past 5 years (data from Illinois Aquaculture TechSERV records).

The caveat to intensive culture of carnivorous species, like HSB, is their need for nutrient-dense, protein-rich feeds. Protein is the most costly fraction of any aquafeed. Currently, the leading source of protein for aquafeeds used for culturing carnivorous fishes is fish meal (FM). Most FM is derived from small oceanic fishes like menhaden, mackerel, herring, etc. However, increasing demand and rising costs of FM (FAO 2008), coupled with static landings of reduction fisheries (FAO SOFIA 2006) have made continued use of FM in aquafeeds environmentally and economically unsustainable. While the goal of aquaculture is to reduce fishing pressure on wild fisheries by provide alternative sources of high quality seafood, by focusing on carnivorous species and using FM, aquaculture can indirectly increase fishing pressure on reduction fisheries. Alternative proteins in the form of animal and plant-derived proteins have been investigated in the past with variable success. However, observed limitations to these alternatives have led nutritionists to investigate new alternatives to FM. New alternatives must not only be suitable for proper fish nutrition but must also be readily available, sustainable and cost effective.

One potential new alternative to FM is yeast-based proteinaceous fermentation biomass (PFB). PFB is a co-product of bioethanol production. Yeast, used in the fermentation of corn, is collected along with unused corn protein and dried creating the aforementioned PFB. PFB is an excellent candidate for FM replacement due to its high protein content and increasing availability.

A previous study at SIUC (Gause and Trushenski, in preparation) has shown that PFB has potential as a partial FM replacement. HSB fed a feed in which PFB replaced 75% of dietary FM performed as well as HSB fed a FM-based feed (control). In fact, HSB reared on a 50% PFB feed performed better than those on the control feed. However, complete replacement of FM with PFB was not successful. Based on daily intake, specific growth rate, feed conversion ratio and visual observation of feeding behavior, it is believed that palatability was the primary issue preventing complete FM replacement with PFB. We believe the addition of a palatability/flavor enhancer like Finnstim, a commercially made palatant/attractant commonly used in aquafeeds, will allow for 100% replacement of FM with PFB. Digestibility and utilization of PFB feeds appears to be quite good—if the fish can be encouraged to readily consume the PFB-based feeds, their growth performance may be equal to that of fish reared on an FM-based feed. The objective of this study, therefore, will be to determine if full replacement of FM with PFB is possible with the addition of palatability enhancers.

(24) RATIONALE (IMPACT OF PROBLEM):

Decreasing the reliance of aquaculture on FM as a protein source will help to reduce the overall cost of producing the popular high value, carnivorous species that are in high demand

throughout the United States. This will ultimately lead to the ability for culturists to increase production and profitability. With more foodfish being supplied by aquaculture, fishing pressure on wild foodfish populations, both marine and freshwater, may decrease. Reduced demand for FM in aquafeeds may also relieve some harvest pressure on reduction fisheries.

HSB are becoming an increasingly popular foodfish and sportfish around the United States. Midwest states like Indiana and Illinois are witnessing this popularity first-hand. This is evident in Illinois where HSB are the leading foodfish in terms of production, and in both states where extensive stocking programs for sport fishing have taken place for many years.

Implementation of a terrestrial protein source, like PFB, in aquafeeds will not only benefit culturists but also farmers who supply the grains that are used in bioethanol production and the biofuel industry itself. Illinois, Indiana and other Midwestern states are currently leading suppliers and producers of corn and bioethanol in the United States, thus the successful implementation of PFB in aquafeeds will benefit other regional industries.

(25) METHODOLOGY:

Juvenile HSB will be reared in recirculating aquacultures systems with associated biological and mechanical filtration. A control feed will consist of 30% FM by dry matter with no palatability enhancer. Experimental feeds will consist of the control feed with a palatability enhancer and a 0% FM feed, in which PFB will replace the protein supplied by FM, with and without a palatability enhancer. A standard feeding trial (500% growth in control group, or 8 weeks) will be carried out.

Production performance will be determined by evaluating intake, specific growth rate, feed conversion ratio and weight gain. To ensure that robustness of HSB is not compromised with increased implementation of PFB, HSB will be monitored for immunological and physiological issues, feed digestibility, nutrient retention, etc.

(26) EXPECTED RESULTS AND IMPACT:

Based on the previous study at SIUC as well as other studies using yeast-based protein alternatives (Oliva-Teles and Gonçalves 2001, Olvera-Novoa et al. 2002), we expect PFB to be an excellent option for FM replacement. Palatability enhancers should allow for PFB to fully replace FM in HSB feeds. This will open up the possibility of replacing FM with PFB in other cultured fish popular in Illinois and Indiana and the rest of the United States (i.e., largemouth bass, various salmonids, etc.). Replacement of FM with PFB will allow for increased production and profit for producers of HSB in Illinois and Indiana and foster growth in aquaculture as a whole as well as support growth in agriculture and bio-fuels production. If complete replacement of FM is not possible, any reduction on the reliance of FM will not only benefit aquaculture and other supporting industries but allow for reduced pressure on fragile wild food fish populations and reduction fisheries.

References:

FAO (Food and Agriculture Organization of the United Nations) 2006. The state of world fisheries and aquaculture. FAO, Rome.

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Olivia-Teles, A., and P. Gonçalves. 2001. Partial replacement of fish meal by brewers yeast (*Saccharomyces cerevisiae*) in diets for sea bass (*Dicentrarchus labrax*) juveniles. Aquaculture 202:269-278.

Olvera-Novoa, M. A., C. A. Martínez-Palacios, and L. Olivera-Castillo. 2002. Utilization of torula yeast (*Candida utilis*) as a protein source in diets for tilapia (*Oreochromis mossambicus* Peters) fry. Aquaculture Nutrition 8:257-264.