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USDA REGIONAL AQUACULTURE CENTER SUPPORTED FEEDS RESEARCH AND DEVELOPMENT IN HAWAII AND THE U.S. AFFILIATED PACIFIC ISLANDS

By Meredith Brooks, the Center for Tropical and Subtropical Aquaculture

THE CENTER FOR TROPICAL and Subtropical Aquaculture (CTSA) is one of five Regional Aquaculture Center's funded under the USDA's National Institute of Food and Agriculture (NIFA). Each center integrates individual and institutional expertise and resources in support of commercial aquaculture development in a defined region; CTSA's region encompasses Hawaii and the U.S. Affiliated Pacific Islands of American Samoa, Guam, the Northern Mariana Islands, the Marshall Islands, Palau, and the Federated States of Micronesia. Research, extension, and education efforts sponsored by CTSA have resulted in the growth of the aquaculture industry in these islands and beyond, with most notable impacts in the areas of disease mitigation, propagation of new species, and sustainable aquatic feeds development.

Since it's inception in 1986, CTSA has funded several projects that incorporate aquatic feed and nutrition research in their respective scopes of work. Most notably, the Center supported the establishment of artificial diets for moi (Pacific Threadfin), milkfish, and Chinese catfish. Currently, CTSA is funding "*Aquaculture of Opihi,*" which includes the development of an artificial diet for opihi, a popular limpet that has been overfished in Hawaii. Dr. Warren Dominy of the Oceanic Institute's (OI) Aquatic Feeds and Nutrition Depart-

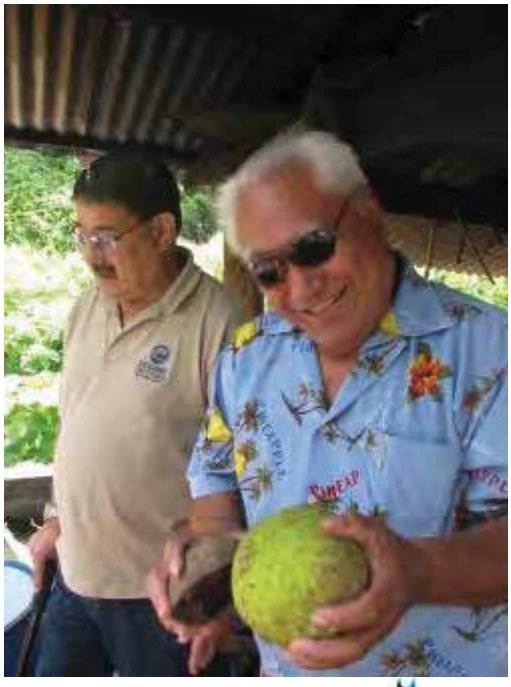
In American Samoa: Francis Leiato, Sea Grant (Left) and Chief Troy Fiaui with his tilapia ponds

ment (AFN) and Dr. Harry Ako of the University of Hawaii (UH) are conducting the project in an effort to bring this high-value species into aquaculture. Dietary research and development of an accessible, nutritious, and palatable artificial feed are essential to the project's success, and stand to increase the probability of their success.

In addition to supporting the establishment of nutrient requirements and diets for new aquaculture species, CTSA sponsors research to explore development of feeds that utilize locally sourced products and byproducts in the Pacific region. One example is the recently completed project "*Bioprocessing Pacific Island By-products for the Production of Value-added Feed Ingredients*," led by Dr. P.Y. Yang of UH and the OI AFN group. Under the auspices of the project, the research group developed a bioreactor system to produce yeast from the papaya sugar waste (off grade discarded papayas) and investigated the possibility of using the papaya waste yeast (PPW) as an alternative protein source for aquatic feed. Upon analysis of the PPW (Figure 1), they formulated five test diets with 0%, 25%, 50%, 75% and 100% of the island grown PPW yeast as a replacement for an imported protein ingredient mixture. The diets were tested in an 8-week feeding trial with Pacific white shrimp (*Litopenaeus vannamei*). Results demonstrated that PPW yeast could effectively replace up to 50% of imported protein ingredients without adverse affects on growth of the shrimp under trial conditions.

Figure 1. Proximate Analysis of the freeze-dried PPW culture (ground and mixed test ingredient)

ASSAY	FD PPW Culture
Dry Matter (%)	95.62
Ash (%)	5.75
Crude Protein (%)	45.15
Crude Fat (%)	1.11
Phosphorous (%)	1.28
Potassium (%)	1.65
Calcium (%)	0.12
Magnesium (%)	0.17
Boron (ppm)	3
Copper (ppm)	34
Iron (ppm)	58
Manganese (ppm)	7
Zinc (ppm)	132



In a similar effort, the OI AFN research group and their collaborators at the American Samoa Community College (ASCC) are carrying out the project "*Analyze and Compile the Nutritional Composition of Potential Feed Ingredient Resources in American Samoa into a Feed Manual for Use in Tilapia Feeds*," which is nearing completion. The project commenced with the refurbishment of the feed processing lab at ASCC to increase its capacity for producing feeds. Sea Grant agent and project Co-P.I., Ephraim Temple then collected samples of fishmeal, while student interns collected samples of bananas, banana leaf, Fa'i banana stalk, breadfruit, cassava, and taro. The samples were sent to the Oceanic Institute for analysis, where researchers found the plant ingredients to be mainly carbohydrate in content, and all but the Fa'i adequate to provide the

Dr. Warren Dominy, director Aquatic Feed and Nutrition Department, Oceanic Institute, Hawaii, and Chief Sefulu discuss the suitability of American Samoan indigenous produce as feed ingredients.

starch portion of the diet. The work group also determined that the levels of essential amino acids and fatty acids in the tuna meal were sufficient to meet the nutritional requirements of a tilapia diet. Once the nutrient analysis was completed, a simple formula was created (Figure 2).

A feed-manufacturing method for adults was developed using standard approaches of weighing ingredients, and was modified to establish a second method applicable to children using a soup can to measure approximate ingredient proportions. The manufactured diets were tested and found to provide sufficient essential amino acids, fatty acids, vitamins and minerals to meet the needs for tilapia growth. A feed manual was created for each method: the children's feed manual was fashioned like a storybook with pictures and was printed in English and Samoan, while the adult manual contained the formulas of the tilapia diet, nutrient analysis of the local starch sources and the fishmeal, and a detailed breakdown of the feed processing methods applicable with the available equipment.

Figure 2. Tilapia diet formulation. Values are on an "As Fed" Basis.

Tilapia Diet	
Ingredient	**%**
Multipurpose Wheat Flour	40.4%
Tuna Fishmeal	26.9%
Cooked Local Starch*	19.2%
Plant oil	1.2%
Vitamin Mix	0.4%
Trace Min Mix	0.4%
Water**	11.5%
	100%

*Cooked Local Starch = ulu or fa'I or taro, etc. Use singularly or in combination. Assumes approx. 60% moisture content.

**Brings Water content of diet up to 30%.

In October 2011, 28 members of the tilapia farming community gathered at ASCC for a workshop to learn the new technology and acquire the manuals. ASCC student interns and Sea Grant staff successfully demonstrated both manufacturing methods at the workshop, and the participants made their own feeds for their tilapia.

Top left to right: Samoan children mash up bananas.

An ASCC intern teaches how to make tilapia feed pellets by pushing dough through a sieve.

Left: Sea Grant agent and project Co-P.I. Ephraim Temple (back row) sends proud families home with their childrens' book, certificates, sieves and tilapia feed

Farther west, the project "*Value Added Approach for Tuna Fish Roe: Local Ingredient for Shrimp Maturation Diet,*" led by Dr. Hui Gong of the University of Guam, is similarly aiming to use byproducts from the local tuna industry. The purpose of this project is to develop new knowledge to sustainably increase the value of underutilized tuna fish roe by exploring its potential usage as an aquaculture feed ingredient in a shrimp maturation diet. Preliminary feeding trials with young shrimp and tilapia showed good acceptance of raw tuna roes. However, it is unknown how effectively tuna roe can boost the maturation process as compared to the conventional fresh-frozen maturation feeding regimes when considering both health and nutrition.

To date, the research group has established the baseline nutritional information of tuna fish roe collected through a Guam tuna fish loining company, including proximate analysis (protein, total lipids, carbohydrates and ash) and fatty acids analysis, etc. They have also verified through PCR that the tuna roe samples were free of major shrimp viruses using. A semi-moist diet using tuna fish roe has been formulated and developed and is currently being tested through a series of trials (Figure 4). If results indicate that locally sourced tuna roe can be effectively used in aquatic feeds, shrimp-hatchery operators will be able to cut costs. In addition, a byproduct that would otherwise be discarded will become a value-added product, providing additional environmental benefits by reducing organic waste.

Impacts from previous CTSA-sponsored projects have resulted in new feeds and increased knowledge of nutrient requirements of multiple popular aquaculture species. The Center looks forward to the outcomes of its ongoing projects, as well as the continuation of its support of research and demonstration projects in the critical feed and nutrition sector of the aquaculture industry.

Figure 4. Tuna fish roe semi-moist diet formulation.

Experiment formula	
Ingredient	% (Raw matter)
Fish Roe (grate blended)	45%
Glutinous rice flour	10%
Soybean meal	13%
Spirulina powder	5%
Black algae powder	1%
Vitamin Mix	1%
Mineral Mix	1%
Soybean oil	1%
Egg	6%
Distilled water	17%
	100%

For more information on CTSA projects, and to see detailed reports from those discussed in this article, please visit www.ctsa.org