# FPRF Technical Services Newsletter

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*"The past does not equal the future."*

*—Anthony Robbins*

## President's Column

Have you ever wonder why the world is green? In 2006, a group of researches at Duke University postulated that predators are, ironically, the key to keep the world green as they keep the number of plant – eating herbivores under control.

In the world of rendering, the word "Green" is certainly not associated to predators and probably pretty poorly understood by the public in general. As coined by Dr. William Gaud, the term "Green Revolution" strives for sustainability and agricultural progress triggered by improvements in technology.

Indeed, "Green" comes in different shades. On one hand "Green" agriculture has been shown to be productive, economic and sustainable for farmers, whether their external inputs are low or high. More recently, "Green" has come to suggest opposition to inorganic fertilizer, concern about its effect on the water and a preference for more traditional agriculture.

Changes in technology, consumer demand, and markets lead the way for the second "Green Revolution" or the development of "Organic Agriculture". But as pointed out by Dr. Thomas L. Dobbs, there is a "very real danger that organic research programs will look more like those of conventional agriculture". If research on conventional agriculture has produced an endless stream of fertilizer response and pesticide application, studies may be 20 years from now; organic research will consist mainly of a similar stream of biological pest control studies on nearly every crop, under every imaginable growing condition.

Sergio F. Nates, Ph.D.

## Country Focus - Panama (by Jaime E. Herrera)


Panama has an extensive protective sea (319,823 $Km^2$), with over 2,700 kilometers of coasts and 1,212 $Km^2$ of lakes. At the present time, shrimp aquaculture production in Panama is concentrated around 9300 hectares. The main species cultivated is the white shrimp, *Litopenaeus vannamei*.

In addition, species such as Tilapia, Chinese Carps, Trout and Cachama (*Colossoma* spp.) are being raised in commercial facilities. Official numbers reveal that the production of marine shrimp exceeded 17.8 million pounds (8,130 tons metric) in 2006, whereas the commercial production of trout reached 523 tons and tilapia 167 tons.

The governing organization that overseas and regulates the aquaculture industry in Panama is the Authority of Aquatic Resources of Panama (ARAP), recently created as the result of the merge between the National Direction of Acuicultura (DINAAC), a dependency of the Ministry of Farming Development (PLANT LOUSE), and the Main Directorate of Marine and Costal Resources (DIGEREMACO), a dependency of the Naval Administration of Panama (AMP).

Among some of the objectives of ARAP are:

a) To identify and facilitate friendly technologies with the environment

b) To improve the quality of life and the economic development of the population, respecting the ecosystem, the biological diversity and the genetic patrimony of the nation.

With this in mind, plans are being put in place in order to develop extensive mariculture projects. Mariculture appears to be the most viable alternative to reach the aforementioned objectives.

## R&D Update (Progress report)

**06B-2** ***Production of Omega -3 Fatty Acid-Rich Algae from Animal Protein Hydrolysate (by Zhiyou Wen and Rafael Garcia)***

Background

Animal proteins are major products of the rendering industry. The traditional market for these products, animal feed, is mature and in some cases threatening to shrink. For example, Canadian officials recently announced by mid-2007 meat and bone meal (MBM) containing any specified risk materials from cattle will be banned from all animal feeds, pet foods, and fertilizers; current EU regulations are even stricter, banning all ruminant tissue from feed for animals other than pets. Given these conditions and the possibility that the United States will further tighten feed regulations, there is an urgent need to develop new markets for large quantities of rendered animal proteins.

The goal of this project is to develop an alternative for utilization of rendered animal protein by growing microalgae on animal protein hydrolysates to produce omega-3 polyunsaturated fatty acids, which have shown beneficial effects on preventing cardiovascular diseases, cancers, schizophrenia, and Alzheimer's. The traditional mass algal culture is limited by high cost of nitrogen sources such as peptone and tryptone. In order to develop a cost-effective mass algal culture process, a less expensive nitrogen source is desired, and animal protein hydrolysate provides such an opportunity.

Objectives

(1) Production of a range of hydrolysates which vary in terms of hydrolysis method, degree of hydrolysis, and raw material source;

(2) Analysis of peptides in terms of properties hypothesized to affect algal performance;

(3) Investigation of algal growth and omega-3 fatty acid production by using protein

hydrolysate as a source of nitrogen and micronutrients;

(4) Characterization of the algal biomass produced.

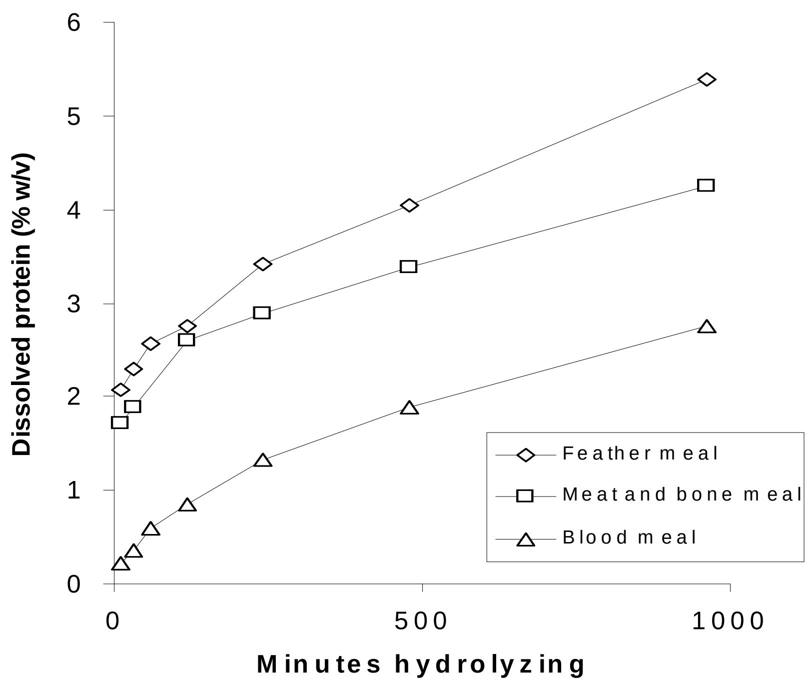
Work conducted in this reporting period

As scheduled in the approved project proposal, work in the last three months has focused on the production and characterization of hydrolysates. Methods to hydrolyze the raw materials, and to clarify and dehydrate the hydrolysate were tested and refined. All alkaline hydrolyzed batches have been produced and transferred to Dr. Wen. The characterization of these batches is partially complete and on-going. Currently, the methods used for the production of the alkaline batches are being adapted for enzymatically produced batches. A difficult filtration step that was not necessary for the alkaline batches is now being tested. Some preliminary data is presented in the appendix page.

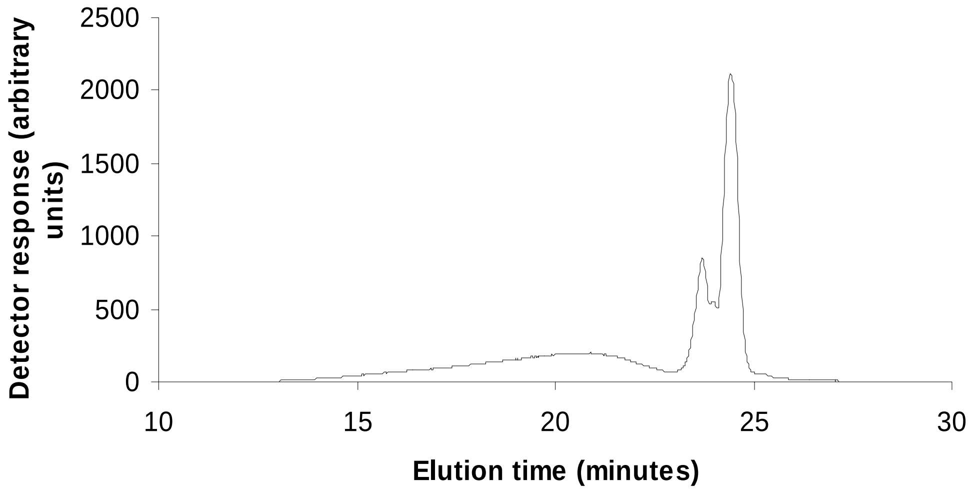
For the algal culture sides, the growth characteristics of the DHA-producing alga *Schizochytrium limacinum* and EPA producing alga species *Phaeodactylum tricornutum* are being determined. The growth characteristics and DHA prodcution by *S. limacinum* are presented in the appendix page. Dr. Wen has received the alkali-hydrolyzed animal proteins, and the test of the growth performance for the two algae species is under way.

Overall, progress and results have come steadily, and we do not anticipate any trouble remaining on schedule.

**Appendixes: 1.** MBM, blood meal and feather meal protein become more soluble as alkaline hydrolysis progresses. Conditions were 85°C, pH ~11.5, atmospheric pressure, vigorous stirring.



**Appendixes: 2.** Size exclusion chromatography analysis of one hydrolysate. The large peaks near 25 minutes indicate that the hydrolyzed protein has been reduced to very small peptides. Smaller peptides should be more soluble and more available to the algal culture.




**Appendixes: 3.** Cell growth, substrate consumption, and DHA production of *S. limacinum***.** (Glucose is used as ac carbon source, peptone/yeast extract are used as nitrogen sources)

| Parameters | Mean ± SD |
|---|---|
| Specific growth rate, μ ($day^{-1}$) | 0.575±0.012 |
| Maximum cell dry weight, $X_{max}$ (g/L) | 18.47±0.25 |
| Biomass productivity (g/L-day) | 3.08 ± 0.06 |
| Growth yield, $Y_{x/s}$ (g/g) | 0.356±0.005 |
| DHA content (mg/g DW) | 165.74±7.82 |
| DHA yield (g/L) | 3.05±0.14 |
| DHA productivity (g/L-day) | 0.51±0.03 |

**The ACREC Update**

**Clemson University Animal Co-Products Research and Education Center (ACREC)**

**by Sergio Nates**

While Dr. David Brune is not an active ACREC faculty participant, his research certainly should be in our interest. His research involves the use of biological systems for environmental impact reduction, environmental remediation and natural resources conservation, using techniques collectively referred to as “Ecological Engineering”.

Ecological Engineering is the design of complex biotic and abiotic processes to preserve, restore, and enhance ecological services. Ecological services are the life support processes humans and other animals depend on from Earth's biosphere. They are defined as the cumulative benefits human populations derive - directly or indirectly - from ecosystem functions. Examples include nutrient cycling, flood attenuation, habitat, carbon fixation, and oxygen generation.

One application in ecological engineering involves the use of a technology developed at Clemson University termed “The Controlled Eutrophication Process”. In this system, large scale, fast growing, open air algal cultures are used to remove waste nitrogen and phosphorus from agricultural drainage and surface waters reducing or eliminating the potential adverse environmental impact of such activities. In these designed ecosystems, captive populations of filter-feeding fish are used in combination with algal growth basins, mechanical algal concentration systems, and fermentation bioreactors to recover and convert algal biomass into high value protein, as well as methane and hydrogen biofuels and biofertilizers.

## Noteworthy Article

Coutand M., M. Cyr, E. Deydier and P. Clastres (2007) Characteristics of industrial and laboratory meat and bone meal ashes and their potential applications. J. Hazard Material (in press).

This paper reports the characterization of four meat and bone meal (MBM) ashes obtained from specific incineration (laboratory) and from co-incineration (industrial process). Three out of the four MBM ashes were mainly composed of calcium phosphates (hydroxyapatite and whitlockite). Their compositions (major and trace) were in the range for natural phosphate rocks. Trace element contents, including heavy metals, were below 0.6% and industrial ashes contained much more heavy metals than laboratory ash. The amounts of leached elements were low, especially for laboratory ash. According to the European classification of waste to be land filled, the laboratory ash can be classified as an inert waste. Two industrial ashes are mostly inert. Only one ash is highly leachable and needs a stabilization treatment to be classified at least in the category of hazardous waste. It seems, from these results, that possibilities other than land filling could be considered to give economic value to these ashes.

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