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"If you plant for a year, grow rice.

If you plant for a decade, grow trees.

If you plant for a century, grow educated men and women."

—Chinese proverb

President's Column

The advent of the new millennium has brought with it an awareness of how far the human race has come with the help of scientific endeavor, accompanied by a sense of hopefulness for the near future. However, coordination across many disciplines is needed; and yet we have not done well in the past at educating young scientists about cooperation, collaboration and synergistic research effort.

On the other hand, the Internet has, in a very brief period, changed very fundamentally the reporting of any research results. Today anyone with access to a screen can check hundreds of abstracts, join chat lines to debate their research findings and tune into teleconferences which were once the exclusive preserve of board executives.

With up to the minute information widely disseminated at web speed, the translation and application of new knowledge to our industry requires somewhat a broader view, with computer technology and the internet suddenly providing an absolute abundance of "information" which, at a distance, seems to be a way of providing the public with freedom from professional paternalism. But careful, on closer inspection, the wave of "information" can turned out to be a poorly sorted mixture of useful wisdom, recently validated data, arguable opinion, and many times untested assertions.

Sergio F. Nates, Ph.D.

Country Focus (by Dr. Victor Suresh – Bentoli Inc.)

Livestock Production

As per the livestock census conducted in 2003, India had the following farm animal population:

	(Millions)
Cattle	185.18
Buffaloes	97.92
Small ruminants	185.83
Pigs	13.52
Other draught animals	2.55
Total poultry	489.01*

(Source: Directorate of Economics and Statistics, Ministry of Agriculture. Livestock Census 2003: Provisional Report. *Poultry population may have been underestimated. As per CLFMA, the Livestock Industry Association of India, the country has an estimated 150 million layer birds and 650 million broiler birds).

In 2003, India is estimated to have produced a total of 5.98 million tonnes of meat, 88 million tonnes of milk, and 40 billion eggs. Despite this large volume of food production from the livestock sector, animal farming in India is still in the hands of small and medium-size farmers.

Major sectors of livestock production in India are (1) dairy cattle; (2) goats and sheep; (3) poultry (broilers and layers); and (4) aquaculture.

Ruminant production and slaughter

The dairy cattle sector in India, though the largest in the world in terms of number of cows and milk production, is highly fragmented and widely distributed throughout the country in the hands of millions of small farmers. In most states of India, a highly successful cooperative system efficiently collects, processes and distributes milk and other milk-derived products. Private companies are also involved in milk distribution.

Cow is considered holy by Hindus who constitute nearly 80% of Indian population. Most Hindus do not eat beef, except for people in the lower rung of economy. Beef is not taboo for Muslims and Christians and also for people of Northwestern states of India. However, cattle are seldom raised for beef production. Cows and she-buffaloes that have stopped milk production and aged bulls that cannot be used in draught are slaughtered for meat. Much of cattle slaughter occurs in an unorganized manner. However, there is some organized slaughtering in cities like Mumbai and Hyderabad and the meat is exported to countries in the Middle East and South East Asia.

Meat of goat and sheep is preferred in most parts of India and commands premium prices. Rearing, marketing and slaughter of the species are not highly organized. The export-oriented slaughterhouses also slaughter the small ruminants for exports.

Poultry production and processing

The broiler and egg production sector in India is well organized. Consumption of broiler meat has grown at an annual rate of almost 15% in India in the last decade. The broiler production sector is technologically advanced and considered to be one of the most efficient globally. There are currently about six major integrators that offer chicks, feed, medicines, technical support and marketing services for farmers and produce their own birds as well. Much of poultry slaughter and dressing is done in outlets that sell the meat. The following companies have facilities for hygienic processing of chicken into products for export or domestic consumption through supermarket chains in the city: Venkateswara Hatcheries, Supreme Suguna, Godrej Agrovet, Arambag, Gold Chick and Komarla. The total estimated processing capacity is 10,000-12,000 birds/hour, only a small fraction of broilers produced in India.

Aquaculture production and processing

India is the second largest aquaculture producer in the world. It is also a top producer of fish and other aquatic animals from marine and freshwater fisheries. India is estimated to have harvested about 5.9 million tonnes of aquatic products (mainly finfish and shellfish) in 2003. Of this quantity, 2.2 million tonnes of fishes, freshwater prawns and marine shrimp were produced through farming. Farmed production of carps dominates Indian aquaculture with an annual production exceeding 1.88 million tonnes. The annual production of farmed shrimp and freshwater prawns is about 140,000-150,000 tonnes. Fish are mainly processed in local wet markets for domestic consumption. Shrimp and freshwater prawns are processed in factories for exports.

Rendered Animal Byproducts

As per a report from the Technology Information, Forecasting & Assessment Council (TIFAC), the total availability of offal/bones in the country generated from large slaughterhouses processing small and large ruminants was estimated to be more than 2.1 million tonnes per annum in 2001. TIFAC estimated that meat and bone meal (MBM) production in India to be about 55200 tonnes per year. The estimated demand was 77500 tonnes per annum. Leading manufacturers of MBM are Standard Agro Vet, Allanasons, Hind Agro, and Al Kabeer. Some manufacturers also produce drum-dried blood meal.

In poultry, only waste from chicken processing factories are processed into byproducts. Organs that are processed include head, claws and intestines. Feathers are not presently processed into byproduct.

The Government of India through its department of Animal Husbandry and Dairying, Ministry of Agriculture, has prohibited the use of animal byproducts in ruminant feeds from 1999 onwards. But, animal byproducts are not commonly used in ruminant feeds in India.

There is an importation ban on many animal byproducts. Fats and oils of animal origin are banned. Importation of live cattle, buffalo, sheep and goat, bovine, ovine and caprine embryo or ova, fresh meat, meat products, tissue, organs and meat and bone meal (MBM) or ruminant origin, as pet food products or ingredients of ruminant origin are prohibited. Claiming to contain Highly Pathogenic Avian Influenza, there is also import ban on products of animal origin intended for use in animal feeding or for agricultural or industrial use.

Feed Ingredients and Manufacturing

As per CLFMA, the livestock association of India, the volume of manufactured feeds in India was about 5 million tonnes in 2005 (see Table). Remaining feeds are farm-mixed. The association estimated that India would require nearly 60 million tonnes of feed if livestock farming were to be primarily based on feed.

Table: Manufactured feeds for livestock and aquaculture production in India

Sector	Feed Demand (million tonnes)	Manufactured feeds (million tonnes)	Information source
Dairy cattle	45	2	CLFMA
Poultry, Broiler	6.21	3	CLFMA
Poultry, Layer	8.13	Not significant	CLFMA
Aquaculture, Fish	2.1	0.01	Victor Suresh
Aquaculture, Prawns	0.24	0.19	Victor Suresh

India is an agricultural economy and is a leading producer of many food crops. The broad agricultural base provides coarse grains, grain byproducts such as bran, and oilseed cake or meals to animal feeding. CLFMA estimated that the following feed resources are currently available from domestic agricultural production for livestock feeding.

	Million tonnes
Oil seed cakes and meals	15.76
Bran	13.26
Coarse grains	5.74*
Others	0.53
Total	35.32

(*This may be an underestimate considering the fact that nearly 7 million tonnes of domestically produced maize goes to the feed industry).

While plant-origin proteins are available in plenty in India, there is a shortage of animal-origin proteins. While the dairy cattle feed sector is not currently constrained by this situation, both poultry and aqua feed sectors can benefit from the availability of good quality animal proteins. Currently, poultry feed sector is using dried fish unsuitable for human consumption and the quality of this raw material is considered to be poor. Shrimp feed sector is relying mostly on imported fishmeal and to some extent on acceptable quality fishmeal produced locally. The increase in global fishmeal prices is impacting the local fishmeal and dry fish prices and prompting interest in alternative proteins. Further, India's large carp production sector is on the verge of converting from farm-mixed blends of rice bran and oil seed meals to manufactured feeds. This development is likely to increase demand for animal proteins as well. The long-term outlook for animal protein meals, either locally produced or imported, is therefore bullish in India.

R&D Update

05B-1 **Comparative study on the capacity in utilizing rendered ingredients as dietary protein sources between fast-feeding and slow-feeding marine fish species**

Objectives: The objective of this project is to compare the capacity between malabar grouper (*E. malabaricus*) and cuneate drum (*Nibea miichthioides*), two commercially important marine fish species widely cultured in China, in utilizing rendered protein ingredients as fish meal substitutes in diets. Sub-objectives include:

1. Examine the potential of malabar grouper to use meat and bone meal (MBM), poultry by product meal (PM), feather meal (FM) and blood meal (BM) as fish meal substitutes in diets.
2. Compare the digestibility of malabar grouper and cuneate drum on MBM, PM, FM and BM, by vitro and invitro methods. To examine the relationships between feeding time and feed intake, and between feeding time and growth performance in malabar grouper and cuneate drum fed diets in which MBM, PM, FM and BM were included at various levels.
3. Examine the effect of adding some attractants such as meat solubles, squid meal, shrimp meal or synthetic amino acids in diets in which PM and BM were included at various levels on feeding time, feed intake, growth performance of malabar grouper and cuneate drum.

4. Examine the possibility to develop fish meal free diets for malabar grouper and cuneate drum using mixture of PM, BM and FM as animal protein sources.
5. Generate the information necessary for developing commercially practical diets for malabar grouper and cuneate drum cultured in marine net pens or cages in China.

Summary of Project Results:

The first feeding trial (GF-1) focusing on the sub-objective 1 was designed as a single factor layout of 8 treatments. Eight isonitrogenous and isocaloric diets were formulated to contain 49% crude protein and 9% lipid, which have been demonstrated adequate for growth of malabar grouper. One control contained 50% steam dried fish meal, and in the other 7 treatments the fish meal was replaced by 25%, 50%, 75% with poultry meal, and by 25% and 50% with meat and bone meal, and by 25% and 50% with feather meal. In addition, one raw fish diet was used as reference for the formulated control diet. The test diets were pelletized with a laboratory extruder in the laboratory of Aquatic Ecology and Fish Nutrition, vacuum packed in nylon bags, and transported from Shanghai to Nanao by road (2 to 3 days needed for the transportation).

The GF-1 started on July 1 in net pens at Nanao Bay, Shantou. Total 1100 grouper were purchased from a marine fish hatchery at Raoping and boated to the experimental site. The fish were graded and weaned to the control diet in 2 weeks, and then 900 grouper were acclimated in 30 experimental pens at 30 fish per pen for 2 weeks, during which the fish were fed the control diet twice daily, prior to the start of the feeding trial.

At the start of the GF-1, the acclimated fish were pooled, group weighed, and randomly distributed in 27 experimental net pens at 30 fish per pen, with 3 replicates for each diet treatment. Initial body weight of the fish was 50.3±0.7 g $fish^{-1}$ (mean ± SD). Three groups each of 3 fish were sacrificed for the determination of initial proximate composition in carcass, liver and whole body. The sampled fish were stored in a refrigerator at –20℃ until analysis. During the GF-1, the fish were fed 2 meals daily at full ration except the rainy days. Malabar grouper usually do not go up to water surface to accept the dropped diet. For observing feeding of the fish, we used a piece of plastic plate to diminish the reflex of light from water surface. By this way feeding behavior of the fish on pen bottom could be observed clearly. For each feeding, 30 to 40 pellets were dropped in each pen cyclically, until no fish accepted the dropped diet actively. Water temperature and salinity at surface were measured daily. The GF-1 was expected to last 8 weeks (ended on August 25). However, if the experimental fish could not double body weight on August 25, the trial will be further extended to September 8. At the end of the trial, fish will be sampled from each pen for determination of proximate composition in carcass, liver and whole body. Tissues will also be collected from liver and digestive tract for histology examination. Samples of the fish and diets, enclosed in temperature constant boxes with ice cover, will be transported to Shanghai by air (5 to 6 hours needed for the transportation), and will be analyzed in laboratory of Aquatic Ecology and Fish Nutrition.

Weight gain, feed intake, feed conversion ratio, nitrogen efficiency, condition factor and proximate body composition among the diet treatments will be examined using one-way ANOVA. The second feeding trial (GF-2) focusing on the sub-objective 5 was designed as a single factor layout of 5 treatments, while the third feeding trial (GF-3) focusing on the sub-objective 4 designed as a two factors layout of 6 treatments. In the GF-2, five isonitrogenous and isocaloric diets will be formulated to contain 49% crude protein and 9% lipid. One control contained 50% steam dried fish meal, and in the other 4 treatments the fish meal was replaced by 25%, 50%, 75% and 100% with a mix of poultry meal, meat and bone meal, feather meal and blood meal (poultry meal: meat and bone meal: blood meal: feather meal = 55%:20%:20%:10%). In the GF-3, six isonitrogenous and isocaloric diets will be formulated to contain 49% crude protein and 9% lipid. One diet contained 50% steam dried fish meal, and the fish meal was replaced by 50% and 75% with a mix used in the GF-2. In the other three diets, 1% squid meal was added in above 3 diets as attractant. The test diets will be palletized, packed and transported as described in GF-1.

The GF-2 and GF-3 are expected to start on August 20 in net pens at Nanao Bay, Shantou. Total 1000 grouper were purchased from a marine fish hatchery at Zhaoan and boated to the experimental site. The fish have been graded and acclimated to the control diet used in the GF-2. The feeding, daily management, weighing and sampling in the GF-2 and GF-3 will follow the procedure described in the GF-1. The GF-2 and GF-3 will last 8 to 10 weeks. In the fourth trial (GF-4) focusing on the sub-objective 2, a basal diet will be formulated to contain 46% crude protein and 7% lipid, with fish meal and soybean meal as protein sources. Cr_2O_3 will be added in the basal diet at 1% as marker. The test diets will be comprised of 70% basal diet and 30% tested ingredients (poultry meal, meat and bone meal, feather meal, blood meal and a mix used in the GF-2 and GF-3. The test diets will be palletized, packed and transported as described in the GF-1.

The GF-4 is expected to start on September 25 or October 8, 4 weeks after the end of the GF-1, in net pens at Nanao Bay, Shantou. The fish used in the GF-4 will be the fish ever used in the GF-1. The fish will be fed the basal diet at least 4 weeks prior to the start of the GF-4. At the start of the GF-4, the acclimated fish will be distributed into 18 net pens at 20 to 30 fish per pen. During the GF-4, the fish in 3 pens were fed the basal diet in excess twice daily, while in the remaining 15 pens, the fish were fed the basal diet of 4 days and test diets of 2 days cyclically. On day 6, day 12, day 18, day 24, day 30 after starting the trial, feces will be collected by scripting, and stored in a refrigerator at –20℃ until analysis. The feces collected from same pen (same test diet) will be polled. The GF-4 will be ended when enough feces are collected for analysis. Logically, the optimal sequence for the trials should be (1) GF-4, (2) GF-1, (3) GF-2 and GF-3. However, this will delay the time for starting the GF-1, GF-2 and GF-3 and may miss the growth season, because malabar grouper grow fast during July and September. Another reason that we arranged our trials at the current sequence is the GF-4 has a relatively low demand on the experimental fish. Grouper maybe the most expensive marine fish species cultured in China.

From May to up to date, a typhoon passed Nanao three times. During the “Pearl” typhoon, our boat was damaged, but fortunately, the typhoon had no apparent influences on the experiment, fish or pens, although the rainfall following the typhoon resulted in low salinity. “Now everything at Nanao looks going smoothly”.

ACREC Update - Do Rendering Methods Inactivate Avian Influenza? By Thomas Scott, Professor

Work sponsored by FPRF and APPI at Clemson University through its Animal Co-Products Research and Education Center (ACREC) is attempting to answer questions regarding the stability of Avian Influenza (AI) virus in byproducts carried through typical rendering processes. Combinations of time and temperature are being examined in order to determine the effectiveness of rendering to successfully inactive any AI that would be found in chickens exposed to the disease. If the rendering process can be found to fully inactivate any and all strains of the AI virus, then it would be possible for rendering companies to accept carcasses of exposed poultry and produce a safe product, free of live viruses.

Clemson scientists Tom Scott, Matt Fitts, Annel Greene and Billy Bridges are conducting trials with virus antigen spiked chicken products. Through a process of temperature and time combinations, chickens are being rendered and the detection of virus antigens evaluated. Annel Greene has designed and developed a process for simulating the heating phase of rendering in a test tube environment with the assistance of statistician Bill Bridges. Both Tom Scott and Matt Fitts are developing methods for detection of the virus antigens. These detections involve antibody-based tests (ELISA and Western immunoblots) and quantitative polymerase chain reactions (qPCR). The ELISA and immunoblots will determine the presence of any intact virus antigens post-rendering, while the qPCR will tell the scientists if translatable AI genetic material is still present in the products. Both indirect and direct ELISAs have been developed for antigen detection in rendered samples.

It is anticipated that small amounts of viral antigen might go undetected with a common enzyme linked antibody, so the additional direct ELISA with a FITC-conjugated antibody has been developed to increase the sensitivity of the test. When viral antigens are undetectable with the direct assay, qPCR can be used to further increase the sensitivity of detection for any virus possibly remaining in rendered products.

South Carolina Livestock-Poultry Health veterinarians Pam Parnell and Julie Helm along with State Veterinarian Tony Caver and Jones Bryan are assisting the scientists with assessment of the experimental rendering procedures.

Noteworthy Article

Al-Masri, M.R. and M. Al-Bachir (2006) Microbial load, acidity, lipid oxidation and volatile basic nitrogen of irradiated fish and meat-bone meals. Bioresource Technology. Article In Press (available *on line - August*).

In this study experiments were carried out to study the effect of different doses of gamma irradiation (0, 5, 10, 15 and 20 kilo gray; kGy) on some nutritive components and chemical aspects pertaining to quality of fish meal and meat-bone meal. The radiation doses required to reduce the total microbial load and *Salmonella* sp. one log cycle (D10) in fish meal and meat-bone meal were determined. Results indicated that gamma irradiation of fish meal and meat-bone meal with 5–20 kGy doses had no effects on the total acidity values but increased the values of lipid oxidation and total volatile basic nitrogen. D10 of total microbial load and *Salmonella* sp. were 833 and 313 Gy for fish meal and 526 Gy and 278 Gy for meat-bone meal, respectively. It can be concluded that radiation processing could be employed in the recycling of fish and meat-bone meals by using them as feedstuffs in poultry diets with no fear of losing their nutritive components.

Agenda - “Emerging Issues and Opportunities” Seminar - Fall 2006

1:00 – 1:45p.m.	"Europe: Overcoming technical obstacles to be a world player again" - Steve Woodgate
1:45 – 2:30 p.m.	"Biodiesel Quality – It’s about the engine, not the feedstock” – Dick Talley, Nova Energy Holding, Inc.
2:30 – 2:45 p.m.	Coffee break
2:45 – 3:30 p.m.	"Product Integrity, Traceability and Certification. Why all links matter to the chain" – Manuel Santana, Cargill Animal Nutrition
3:30 – 4:15 p.m.	“Biodiesel synthesis: assessment of current and potential technologies using heterogeneous catalysis.” – Dr. Edgar Lotero, Clemson University
4:15 – 5:00 p.m.	“Food production in a world of change - The perspective of equity” – Dr. Don Franco

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