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" The only thing we know about the future is that it will be different"

- Peter Drucker

President's Column

I'm always fascinated with the interactions between humans and technology. Fascinated on why things work the way they do, and as a native South American of course soccer!

As we approach the last game of the 2010 World Cup, FIFA has just acknowledged that there may be something wrong with the ball that has been used in every game, and even aerodynamic experts at NASA's Ames Investigation Center have come forward with research that inculpates the 440-gram "*Jabulani*" Adidas® ball.

The preliminary research on the *Jabulani* was conducted by Professor Derek Leinweber, Head of the School of Chemistry & Physics at the University of Adelaide, who has previously written about and lectured on the aerodynamics of cricket balls and golf balls. He predicted that the new ball created for the 2010 World Cup, will play "harder and faster", bending more unpredictably than its predecessor. The *Jabulani* is textured with small ridges and 'aero grooves' and represents a fundamental change from the ultra-smooth "*Teamgeist*" ball, which was used in the last World cup. The surface of the soccer ball is made up from synthetic leather and not full grain leather (as used in the past) because leather has a tendency to absorb water causing the ball to become very heavy.

In a recent statement, NASA experts have also reported that most of the South African World Cup stadiums are located at more than 1,000 meters above sea level, which may further aggravate the ball's tricky trajectory. At altitude, the air pressure is lower, and so are aerodynamic effects such as drag and lift, ultimately causing balls to travel faster and straighter than they would at lower altitude. Thus, the same kick in Johannesburg compared with one at sea level would cause a soccer ball to travel faster and on a less curved path.

So is soccer research really apparently irrelevant? The NSF, in the Social, Behavioral and Economic Sciences directorate, just funded a research project to statistically identify true soccer stars based on objective measures. The project is the outgrowth of an effort to develop transparent, statistically-sound methods to describe the productivity of researchers and institutions, and the impact of their work. I can't think of a better topic to discuss during our next "Strategic Planning" meeting.

Sergio F. Nates, Ph.D.

Country Focus (Bangladesh)

Aquaculture Industry

Bangladesh is a nation uniquely positioned to cultivate and harvest fish—situated at the confluence of numerous rivers and tributaries, and occupying the delta of three major transboundary rivers, the Ganges, Jamuna, and Brahmaputra. Currently, Bangladesh is the worlds' fourth largest producer of inland fish. The fisheries sector generates over US$ 390 million a year and contributes 5.0 percent of GDP at constant prices and about 5.6 percent of total exports.

Currently, 36 shrimp species are harvested and cultivated in Bangladesh but coastal aquaculture consists mainly of two shrimp species (*Penaeus monodon* and *Macrobrachium rosenbergii*). Two regions dominate shrimp production, accounting for approximately 95 percent of the total area dedicated to shrimp culture: Chittagong-Cox's Bazaar and Khulna-Shatkira-Bagerat. Brackish water aquaculture is widespread throughout Satkhira, Khulna, Cox's Bazaar, and Bagerhat. The Bangladesh Frozen Food Exporters Association estimates that there are about 37,397 shrimp farms in Bangladesh many of which are small. It is estimated that the overwhelming majority of these farms is less than 2 hectares in size. Although production volumes vary enormously, average productivity is low.

Feed Industry

The Bangladeshi feed industry consists of more than 50 active companies and over 250 registered companies with the Registrar of Joint Stock Companies and Firms. The sector annually produces around 2 million tons of feed, mainly for poultry.

At present, individual firms and processors self-regulate their feed production against self-propped quality and parameter standards. However, on June, 2010, the Bangladesh parliament announced that will frame the 'Fish and Poultry Feed Act' and the 'Hatchery Act' to regulate fish and animal feed production, prevent contamination and deal with other compliance issues. The laws will cover the country's score of feed producers and importers. Farms, feed manufacturing factories including landing/auction centers, depots, processing and export units will be registered and brought under a licensing system. All feed and feed ingredients will have to be sealed and packed with labels mentioning date of manufacturing, date of expiry, and a composition list.

Poultry Industry

Two main systems of poultry production are common in Bangladesh today: commercial poultry production – where birds are kept in total confinement and traditional scavenging or semi-scavenging poultry production. Approximately 20% of the protein consumed in Bangladesh originates from poultry. Among poultry species, the chicken population is dominant over others, at almost 90%, followed by ducks (8%) and a small number of quail, pigeons and geese. Free range ‘backyard’ and scavenging poultry that are traditionally reared by rural women and children still play an important role in generating family income. Productive and reproductive performance of indigenous birds is relatively very low (35-40 eggs and 1-1.5 kg meat per bird per year). Since 1990, a number of farms have been established and today 109 hatcheries are in operation, 18 breeding farms are fully environment controlled, and 85% hatcheries produce only broilers. Feed consumption by the poultry industry is presented in Table 1.

Table 1. Feed Consumption by Poultry Industry (1995-2005)

Particulars	Year		
	1995	2000	2005
Layer feed (MT)	0.40	0.62	1.1
Broiler feed (,,)	0.097	0.341	0.8
Cockerel feed (,,)	0.031	0.044	0.057
Total feed required (MT)	0.528	1.055	1.8
Industrial feed (MT)	0.018	0.276	0.935
of total Feed			
Industrial feed usage			
Layer	3%	20%	18%
Broiler	7%	42%	90%
Cockerel	2%	20%	30%

R&D Update (Final report)

08A-2 **Energy partitioning for white shrimp *Litopenaeus vannamei* fed rendered animal proteins – Jorge A Suarez, Ph.D.**

A poultry by-product meal replacing fish meal did not affect the digestive process of shrimp. Shrimp showed a lower energy expenditure with marine meals but the difference is acceptable for incorporation of rendered proteins in feeds. There is an advantage to rely on a digestive process under physiological conditions for an

ingredient evaluation. Ingredient digestibility could be measured far more readily than nutrient availability and has been the estimate most widely reported in the literature and used in feed formulation (Lee and Lawrence, 1997). Although this topic had largely been covered in recent years (Fox et al., 2004), its importance resurfaced with the growing pressure on fishmeal demand.

In this study, diets were evaluated for digestibility by a strain of *L. vannamei* shrimp. The results were then used to establish an energy budget and trace the energy derived from both protein and energy fractions in each diet. All parameters derived from oxygen consumption were measured to determine an energy budget calculated on a 24h basis.

Experimental design

At a local research facility, all shrimp were from CENIACUA. Shrimp were derived from a selection process to the F7 generation. The average rate of inbreeding per generation was 0.24%.

Diets and ingredients

The feed ingredients used in this study were obtained from commercial suppliers through the AGRINAL® pilot feed mill plant. Poultry by-product meal (PBM) was supplied by a FPRF supporting member in the U.S. The nutrient composition of PBM is presented in Table 1.

Table 1. Analytical composition of poultry by-product meal (PBM) on % as fed basis

	%
Protein (Nx6.25)	56.8
Lysine	3.29
Arginine	3.65
Histidine	1.38
Leucine	3.71
Isoleucine	1.87
Valine	2.54
Threonine	2.02
Methionine	0.9
Phenylalanine	2.2
Tryptophan	0.48
Crude fat	13.52
Moisture	3.89
Ash	22.39

The diets were formulated on an as-fed basis and are presented in Table 2. Diets were prepared by mixing dry ingredients for 10 minutes. Liquid ingredients were added and the mixing continued for an additional 10 minutes. For pelleting, a Torrey meat grinder with 1.6 mm diameter die was used. Celite®NF at 2% (acid-washed standard Super-Cel® NF, Celite Corporation, Lompoc, CA, USA) was included in the experimental diets as an inert indicator.

Between several markers, celite was chosen for the present study based on the performance criteria required for such a compound. In fish, an endogenous marker such as acid-insoluble ash produced large variation in results (Morales et al., 1999). However, coefficients of variation obtained from *L. vannamei* were below 4%, an acceptable range for shrimp.

Table 2. Diet composition (% as fed) of reference and tests diets

	Reference Diet	PBM
Fish meal	33	23.1
Squid meal	3.0	2.1
Soybean meal	17	11.9
Corn gluten	12	8.4
wheat flour	25.3	17.0
Fish oil	4	2.8
Soybean lecithin	2	1.4
Cholesterol	0.5	0.35
Vit. & min. premix[a]	0.99	0.99
Celite[b]	2	2
Poultry meal[c]		30

[a] Vitamin and mineral premix includes (IU/kg or g/kg or mg/kg of premix): Vit. A, 10000 IU/g; B_1, 30 mg/kg; B_2, 15 mg/kg; DL Ca pantothenate, 50 mg/kg; B_6, 35 mg/kg; B_{12}, 40 mcg/kg; Ascorbic, 150 mg/kg; K_3, 3 mg/kg; D_3,3500 IU/g; E, 150 IU/g ; niacin, 100 mg/kg; folic acid, 4 mg/kg; biotin, 1000 mcg/kg; Mn, 40 mg/kg; Zn, 40 mg/kg; Cu, 25 mg/kg; Fe, 100 mg/kg; Se, 0.3 mg/kg; I, 0.35 mg/kg. [b] Celite. Acid-washed standard super-cel ®NF. Celite corporation, Lompoc, CA, USA. [c] Poultry by-product meal (USA).

The chemical contents of the experimental diets were obtained and are given in Table 3. Protein content was around 40% and loss in dry matter remained at an acceptable level, inferior at less than 15% after an hour.

Table 3. Analytical composition of experimental diets (% as fed)

	REF[c]	PBM
Protein (Nx6.25)	40	46
crude fat	8	11.6
carbohydrate[a]	29.5	20.9
GE (kJ/g DM)	19.3	19.5
crude fiber	2.5	2.3
moisture	10.2	8.8
Ash	9.8	10.4
% DM loss[b]	12.7[a]	11.1 [b]

[a] carbohydrate (by difference). [b] stability of the diets in dry matter after 1 h-immersion in seawater (Aquacop 1978). Values were means of four replicates. Means within columns with the same letter were not significantly different at $p<0.05$. [c] Reference diet abbreviated as REF

In vivo digestibility

For in vivo digestibility studies, shrimp with an average weight 15±0.9g, were transferred from the grow-out ponds in CENIACUA. Diet treatments were randomly assigned in 8 outdoor 1,200 liter fiber tanks (2/m2 bottom) with 40 shrimp per tank. Shrimp were fed twice daily at 0800 and 1200h. Thirty minutes after feeding, the tanks were brushed out to remove uneaten feed. One hour later fecal matter were siphoned from each tank twice a day (9:30 and 13:30h), and were gently rinsed with distilled water to eliminate excess salts. Daily fecal samples from each treatment were pooled together. Acid-insoluble ash (AIA) content in diets and fecal matter was determined as described by Atkinson et al. (1984).

Respirometry trial and energy budget

Shrimp with average weight of 0.125g were acclimatized to the dietary treatment for 58 days prior to commencement of the experiment. The technique described earlier (Gauquelin et al. 2007) was applied to *L. vannamei*. Twelve shrimp per treatment were randomly taken (4.9±0.6 g average weight) for respirometry trials and energy budget calculations.

The information from the feeding trial was used to build an energy budget following the established nomenclature (NRC 1981) and was based on energy partitioning, taking into account the following steps: intake (IE), digestible energy (DE), metabolizable energy (ME), urinary and branchial excretion (UE+ZE) and basal metabolism (HeE).

Two chambers without animals were used as controls for each ten chambers stocked with shrimp. A metabolic chamber with continuous flow rate (Rosas et al. 1998) allowed us to measure oxygen consumption individually for 12 shrimp (4.9±0.6 g average weight) on each diet. Oxygen consumption transformed with the oxycalorific coefficient 13.6kJ g-1O2 (Cho & Bureau 1998) yielded a value for heat production (kJ). Urinary and branchial excretion (UE+ZE) was calculated from the following equation: $UE+ZE=0.08*(RE+HeE+HiE+HxE)$ from Bureau et al. (2000), without taking into account the last item (HxE) due to the short duration of the study.

Results

Apparent digestibility

The reference diet was readily digested by juvenile shrimp. Some 30% of the fishmeal content was replaced by poultry meal protein sources in the test diets without a significant effect on digestibility. The apparent digestibility coefficients (ADC) for dry matter, protein and energy of the diets are presented in Table 4.

There were no significant differences between REF and PBM in ADC of dry matter, protein and energy ($p>0.05$). Values for the poultry by-product meal (PBM) in *L. vannamei* were high and greater than 85%. All parameters derived from oxygen consumption were measured to determine an energy budget calculated on a 24h basis.

Table 4. Shrimp diet ADC (±S.D.) for dry matter, protein and energy

ADC	REF.	PBM
Dry matter	83.9±0,43a	84.9±3,69a
Protein	90.8±0,21a	92.1±2,06a
Energy	88.2±0,76a	88.0±3.5a
Values are means of four replicates±S.D. Means within columns with the same letter are not significantly different at P>0.05.		

The protein, dry matter and energy digestibility of the ingredients, poultry by-products meal (PBM), soybean meal (SBM), feed pea meal (FPM), and canola meal (CNA), are presented in Table 5. PBM digestibility values are in accordance to those reported by Suárez et al. (2010: in review) for ADC of dry matter, protein and energy obtained for soybean meal and feed pea meal in *L. vannamei*. Amongst these ingredients, the canola meal showed the lowest ADC for dry matter at 64%, ADC of protein at 89% and ADC of energy at 75% (Suárez et al., 2010: in review).

Values of digestibility for diet were in a good range and obviously it led to similar values for ingredients as far as the additivity of digestibilities remains valid.

Table 5. Ingredient ADC (±S.D.) for dry matter, protein and energy

Ingredients	PBM	*SBM [a]	*FPM [b]	*CAN [c]
ADC dry matter	87.4±5.4	80.0±3.8	87.0±5.0	64.0±8.2
ADC protein	95.1±6.87	96.7±2.7	97.9±3.7	89.4±4.8
ADC energy	87.7±6.07	88.9±3.4	93.9±2.6	75.5±6.4
Values are means of four replicates ±S.D. * digestibility reported by Suárez et al. (2010): in review. [a]soybean meal (SBM),[b]feed pea meal (FPM),[c]canola meal (CNA).				

Energy budget

Animals (4.9±0.13g) fed experimental diets on a weekly basis were used to obtain the energy budget, the results of which are given in Table 6. The reference diet provided higher DE values (1.26 kJ/shrimp/day) than PBM (1.17 kJ/shrimp/day). The estimated value in kJ/shrimp/day from UE+ZE for REF and PBM was very similar. Energy used for maintenance metabolism (HeE) change at the dietary protein levels used for this experiment (REF: 40% crude protein, PBM: 46% crude protein). PBM provided higher HeE values (0.37 kJ/shrimp/day) than REF (0.31 kJ/shrimp/day). Heat increment of feeding with PBM provided higher HiE values (0.18 kJ/shrimp/ day) than REF (0.16 kJ/shrimp/day). The difference in recovered energy (RE) in kJ/shrimp/day between REF and PBM was 24% in favor of REF.

Table 6. Impact of feed composition on energy budget (kJ/shrimp/day) for individual animals placed in a metabolic chamber for 24 h.

	DE[1]	UE+ZE[2]	HiE[2]	HeE[4]	RE[5]
REF	1.26	0.04	0.16	0.31	0.74
PBM	1.17	0.05	0.18	0.37	0.56

[1]DE: digestible energy values from ADC experiment [2]UE+ZE: urinary and gill excretion (Bureau et al., 2000) [3]HiE: heat increment of feeding on the basis of one meal per day
[4]HeE: maintenance based on value measured at t_0
[5]RE: recovered energy.

Discussion

Two possible ways for measuring digestibility; in vivo or in vitro could be applied considering previous research in this field. The in vivo method was adopted despite it being time consuming because of the long-term collecting periods.

ADC of dry matter measured total quantity digested for an ingredient (Brunson et al., 1997). ADC of dry matter for *L. vannamei* fed PBM in this trial was 87.4%. Protein digestibility in the experimental diet was found to be high and greater than 90%. High ADC protein values in the present study were in accordance with values reported previously by Cruz-Suárez et al. (2007) for PBM-PFG (poultry by-product meal-pet food grade).

However, further experiments would be necessary to investigate protein level influence on ADC (Cousin et al., 1996) and associative effects on protein sources related to heat increment variation (Koshio et al., 1993). Our results are also in the line of those reported by Suárez et al. (2010; in review) for ADC of dry matter, protein and energy obtained for soybean meal (SBM) and feed pea meal (FPM) in *L. vannamei*.

There were no differences related to DE between the reference and PBM diet. Interestingly, the energy budget showed a difference in HeE and HiE. It is evident that marine protein sources produce lower energy expenditure in HeE and HiE than poultry by product meal in a first approximation. The difference in recovered energy (RE) in kJ/shrimp/day between REF and PBM was 24% in favor of REF. However, such differences remained acceptable for PBM and indicative of a possible incorporation of rendered protein in a compounded feed for shrimp.

The formulation in the present study did not produce negative effects on ingestion, and the experimental diets formulated with poultry by products meal ingredients showed no decrease in digestibility as compared to the reference diet, indicating that PBM components replacing fish meal in this study did not affect the digestive process of shrimp.

Noteworthy Article

Perai AH, Nassiri Moghaddam H, Asadpour S, Bahrampour J, and Mansoori G. (2010) A comparison of artificial neural networks with other statistical approaches for the prediction of true metabolizable energy of meat and bone meal. Poult Sci. 89(7):1562-8.

Abstract

There has been a considerable and continuous interest to develop equations for rapid and accurate prediction of the ME of meat and bone meal. In this study, an artificial neural network (ANN), a partial least squares (PLS), and a multiple linear regression (MLR) statistical method were used to predict the TME(n) of meat and bone meal based on its CP, ether extract, and ash content. The accuracy of the models was calculated by R(2) value, MS error, mean absolute percentage error, mean absolute deviation, bias, and Theil's U. The predictive ability of an ANN was compared with a PLS and a MLR model using the same training data sets. The squared regression coefficients of prediction for the MLR, PLS, and ANN models were 0.38, 0.36, and 0.94, respectively. The results revealed that ANN produced more accurate predictions of TME(n) as compared with PLS and MLR methods. Based on the results of this study, ANN could be used as a promising approach for rapid prediction of nutritive value of meat and bone meal.

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