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FPRF Technical Services Newsletter

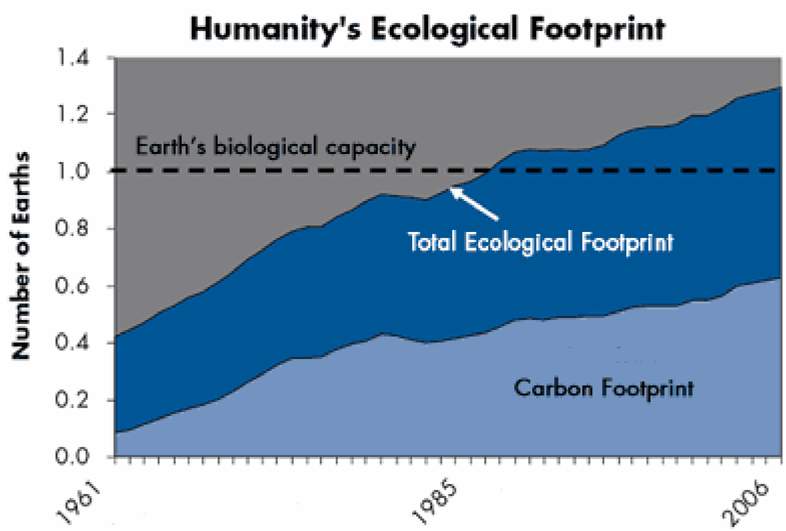
“The best way to predict the future is to invent it.”

—Alan Kay

President’s Column

The debate about climate change has been intense for a few years now and it is certainly beginning to heat up. Likewise, the “Carbon footprint” idea just seems to be reaching a new dimension.

The “Carbon footprint” is a measure of the impact human activities have on the environment in terms of the amount of greenhouse gases produced. It is measured in units of carbon dioxide (CO_2). The carbon footprint can be seen as the total amount of carbon dioxide and other greenhouse gases emitted over the full life cycle of a product or service. Specifically, a carbon footprint is usually expressed as grams of CO_2 equivalents, which accounts for the different global warming effects of different greenhouse gases.



In a way, it is kind of neat that corporations are starting to label products with the carbon footprint prominently displayed on the packaging. However, Carbon is not the only measure of environmental impact. Another hidden impact is the embodied water in foods. Water is exported and imported in the sense that food grown in one country requires water for its growth, so the producing country is selling virtual water to the importing country.

At the end, the idea is to get consumers talking about socially responsible, eco-friendly products, and I can foresee how the rendering industry will not be part of the discussion.

Sergio F. Nates, Ph.D.

Country Focus – Trinidad and Tobago (by Don Franco)

The islands of the Caribbean are predominantly energy importers, with the exception of Trinidad and Tobago. Trinidad and Tobago stands out in the energy field as it maintains a balance between production and consumption. Its present industrial "boom" period has been fueled to a great extent by the expansion of the energy sector which represents 85% of the country's export and 37% of its public income.

At present, Trinidad and Tobago provides 70% of all the liquefied natural gas and methanol imported by the United States. It also stands out as the largest ammonia and methanol producer in the world. Currently, Trinidad and Tobago produces 150,000 barrels of oil and 4,200 million cubic-feet of natural gas per day. The country possesses seven methanol plants, twelve ammonia plants and is planning to build and ethylene plant.

Within the livestock, the broiler industry is today the largest industry, highly concentrated with a few integrators accounting for almost all the industry's production. It is estimated that it contributes over 86% of all meats consumed and more than 96% of the chicken meat consumed in the country. In 2005, Trinidad and Tobago produced over 60,000 MT of chicken meat, and more than 10 million shell eggs, which represented over 25% of the total produced by the countries in the Caribbean belonging to Caricom.

R&D Update (Progress report)

05A-7 ***Metabolizable Energy Value of Meat and Bone Meal (by Layi Adeola)***

Objectives:

1. Determine the metabolizable energy (ME) contents of a variety of samples of meat and bone meal for pigs.
2. Assess the variation in metabolizable energy contents of meat and bone meal and develop robust regression equations that relate the variation to chemical composition.
3. Investigate the use of near-infrared reflectance spectroscopy (NIR) in predicting the ME content of MBM for pigs. This aspect of the objective will use the 12 MBM samples from phase I and the 21 MBM samples from phase II of the MBM ME project.

Summary of Work to Date.

Twenty-one samples of meat and bone meal (porcine and bovine origins) were selected, analyzed for proximate composition, and used in experiments to determine the energy value for pigs.. The samples selected represented a narrower range in chemical composition than used in phase I of the MBM ME project.

Given that ME values are extremely difficult to determine directly using MBM as the sole source of dietary energy, each of the 21 MBM samples is used in test diets formulated by replacing the same proportion of corn and soybean meal (SBM) and all of limestone and dicalcium phosphate of the standard diet with 100 g meat and bone meal sample/kg (Table 1). Corn and SBM are adjusted to constant ratio (745:255 for the standard diet and 745:255 for the test diet containing 100 g MBM/kg) in the substitutions.

Because all the energy in the standard diet is derived from corn and SBM, this constant ratio is key for algebraic equations (described below) used in the indirect method of ME determination to derive the metabolizable energy (ME) content (in kcal/kg) of MBM. The same batch of corn, SBM, dicalcium phosphate and limestone are used for formulating all diets, the only source of variation is each of the 21 MBM samples.

The 21 MBM samples were shipped to Purdue University in 3 groups of 7 MBM samples per group. For each group of 7 MBM samples, 8 diets consisting of 1 standard diet (SD) and 7 test diets (TD) were fed to 72 Yorkshire-Landrace barrows in the weight range of 30 to 35 kg giving 9 barrows per diet. The SD and TD were fed to barrows in a metabolism assay that employed a 5-d adjustment followed by a 5-d period of total but separate collection of feces and urine. Pigs were housed in stainless-steel metabolism crates that allow separate collection of feces and urine using protocols described by Adeola and Bajjalieh, (1997). Details of this procedure are in the last project funded by FPRF (phase I of the MBM ME project).

The chemical analyses of the 3 groups of 7 MBM samples conducted at Purdue University are presented Tables 1 to 3. Animal work is completed on all three groups of meat and bone meal samples received. In line with what was done during Phase I of the meat and bone meal project, meat and bone meal samples were sent to the Agricultural Experiment Station Chemical Lab at the University of Missouri for proximate and amino acid composition analyses.

Table 4 contains dry matter, crude protein, ether extract, phosphorus, and calcium; chemical analysis and Table 6 contains amino acid analysis reports of the 21 samples received from the Agricultural Experiment Station Chemical Lab at the University of Missouri.

The metabolizable energy values for 14 samples in the 2 groups are presented Table 5. Gross energy values of the 14 MBM samples range from 3,895 to 5,193 kcal/kg of DM. In the 14 MBM samples, the digestible energy values range from 2,669 to 4,252 kcal/kg. The preliminary AME and AMEn values for the 14 samples range from 2,611 to 3,911 and from 2,512 to 3,806 kcal/kg, respectively.

Table 1: Chemical analysis (DM basis) of group 1 meat and bone meal samples

Sample Number	DM %	GE kcal/g	CP %*	Ether Extract %	Phosphorus %	Calcium %	Ash %
101	98.4	4.27	55.1	14.1	5.6	8.7	27.5
102	96.1	4.66	63.8	10.8	3.8	5.7	21.6
103	97.5	4.17	56.0	11.1	4.9	8.6	27.3
104	95.4	4.61	61.6	14.4	4.3	6.9	21.5
105	95.5	4.27	59.2	10.8	4.6	8.0	26.2
106	97.6	3.90	47.8	13.6	5.8	9.3	32.8
107	98.9	3.97	46.7	10.7	5.0	7.9	30.6

* N x 6.25
Brief description of MBM samples contained on the labels:
101 - Contains ruminant feed
103 – All pork
104 - Mixture: beef 75%, pork 10%, chicken 10%, fish 5%. Raw material approx 70% retail and 30 % slaughter house
105 – High essential amino acid, 57% meat meal

Table 2: Chemical analysis (DM basis) of group 2 meat and bone meal samples

Sample Number	DM %	GE kcal/g	CP %*	Ether Extract %	Phosphorus %	Calcium %	Ash %
115	98.9	5.08	53.5	13.2	1.9	2.5	13.8
116	98.9	5.11	49.2	13.2	2.0	2.6	14.7
117	99.0	5.19	54.9	14.0	2.1	2.6	14.2
118	99.8	4.64	58.4	9.9	4.1	7.3	25.3
119	99.3	4.63	60.3	10.5	3.7	5.7	23.1
120	99.8	4.25	59.1	10.3	2.6	4.3	22.1
121	99.8	4.70	60.6	11.6	2.9	5.4	21.5

* N x 6.25
Brief description of MBM samples:
115-117 – No description available, none was supplied by suppliers (Valley Protein, Inc. VA)
118-121 – Mixture of beef, pork and poultry products.

Table 3: Chemical analysis (DM basis) of group 3 meat and bone meal samples

Sample Number	DM %	GE kcal/g	CP %*	Ether extract %	Phosphorus %	Calcium %	Ash %
108	98.2	4.72	62.9	9.4	3.9	6.5	22.2
109	98.5	4.77	64.6	10.0	3.5	7.0	20.3
110	98.7	4.76	62.4	9.6	3.6	7.0	21.0
111	98.9	4.73	63.7	10.5	4.0	7.4	20.9
112	98.9	4.72	62.4	10.4	4.0	7.2	22.9
113	99.2	4.79	61.4	10.6	4.1	8.0	23.0
114	99.1	4.70	61.8	11.3	3.8	7.4	22.0

* N x 6.25
Brief description of MBM samples:
108-114 – No description available, none was supplied by suppliers

Table 4: Chemical analysis (DM basis) of all the meat and bone meal samples (21) as analyzed by Missouri Experimental Station Chemical Laboratory

Sample Number	DM%	CP %*	Ether extract %	Phosphorus, %	Calcium %
101	96.0	54.9	10.5	4.7	9.5
102	93.9	64.1	10.1	3.8	7.1
103	95.2	57.1	10.5	5.1	10.3
104	94.6	60.1	11.9	3.7	8.0
105	93.9	61.2	9.2	4.7	9.3
106	95.6	49.1	12.0	5.6	11.6
107	96.5	51.4	12.1	5.1	10.7
108	96.2	63.1	10.1	3.7	6.7
109	96.5	62.9	10.7	3.2	6.6
110	96.4	63.2	10.2	3.6	6.5
111	96.6	55.4	10.9	3.8	7.7
112	96.3	62.6	11.2	3.9	7.3
113	96.7	62.1	11.1	3.9	7.3
114	96.7	61.9	11.5	3.8	7.8
115	94.2	57.0	13.6	2.3	3.8
116	94.4	56.9	13.5	2.4	4.1
117	94.5	57.3	14.1	2.3	3.7
118	97.1	57.1	11.1	4.4	9.7
119	95.3	62.6	10.5	4.2	7.9
120	96.9	56.7	10.6	3.0	8.7
121	96.7	59.4	11.6	3.5	7.0

* N x 6.25

Table 5: Preliminary energy values of 14 meat and bone meal samples

Sample	GE, kcal/kg	DE, kcal/kg	AME, kcal/kg	AMEn, kcal/kg
101	4,269	3,658	3,384	3,283
102	4,657	3,389	3,080	2,963
103	4,167	3,967	3,762	3,661
104	4,605	4,252	3,842	3,733
105	4,270	3,185	2,840	2,729
106	3,895	2,669	2,611	2,512
107	3,968	3,241	3,101	3001
115	5,077	3,670	3,160	3,053
116	5,106	3,863	3,581	3,479
117	5,193	4,234	3,911	3,806
118	4,640	3,033	2,804	2,694
119	4,627	3,385	2,991	2,875
120	4,247	3,468	3,031	2,922
121	4,697	3,696	3,346	3,237

Table 6: Amino acid analysis (%, as is basis) of all the meat and bone meal samples (21) as analyzed by Missouri Experimental Station Chemical Laboratory

Sample number	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121
Indispensable amino acids																					
Arginine	3.44	3.80	3.71	3.78	3.76	3.20	3.35	3.61	3.66	3.63	3.61	3.77	3.72	3.67	3.24	3.21	3.26	3.66	3.96	3.49	3.67
Histidine	1.02	1.52	0.95	1.28	1.14	0.78	0.82	1.42	1.44	1.45	1.34	1.39	1.39	1.35	1.29	1.23	1.29	1.10	1.06	1.25	1.37
Isoleucine	1.56	2.12	1.49	2.12	1.74	1.26	1.31	2.08	2.11	2.02	2.01	2.01	2.00	1.99	2.00	1.91	2.01	1.69	1.92	1.90	2.01
Leucine	3.21	4.13	3.17	4.01	3.49	2.69	2.84	3.96	3.96	3.87	3.80	3.83	3.81	3.73	3.73	3.58	3.72	3.42	3.79	3.65	3.87
Lysine	2.96	3.81	2.78	3.70	3.13	2.36	2.34	3.66	3.72	3.73	3.57	3.68	3.67	3.62	3.00	2.90	3.02	2.98	2.85	3.23	3.46
Methionine	0.70	1.02	0.73	1.07	0.79	0.61	0.59	0.96	0.96	0.94	0.95	0.94	0.93	0.93	0.84	0.83	0.86	0.82	0.78	0.94	0.95
Phenylalanine	1.77	2.22	1.72	2.16	1.93	1.50	1.57	2.14	2.12	2.10	2.05	2.06	2.06	2.02	2.05	1.97	2.04	1.89	2.12	2.02	2.10
Threonine	1.62	1.95	1.66	2.07	1.78	1.38	1.38	2.10	2.04	2.03	1.98	1.96	1.95	1.86	1.87	1.79	1.82	1.68	1.91	1.81	1.94
Tryptophan	0.40	0.47	0.35	0.50	0.42	0.32	0.29	0.46	0.47	0.47	0.40	0.44	0.42	0.43	0.36	0.36	0.43	0.35	0.33	0.45	0.47
Valine	2.31	2.94	2.25	2.79	2.57	1.90	2.04	2.69	2.74	2.59	2.63	2.64	2.63	2.62	2.60	2.51	2.61	2.42	2.89	2.61	2.71
Dispensable amino acids																					
Alanine	3.77	4.23	3.71	3.91	4.02	3.41	3.71	4.01	4.01	4.06	4.07	4.14	4.12	4.07	3.42	3.38	3.42	4.04	4.13	3.66	3.94
Aspartic Acid	3.83	4.66	3.82	4.65	4.11	3.29	3.41	4.76	4.66	4.62	4.62	4.54	4.51	4.45	4.20	4.10	4.21	4.06	4.22	4.24	4.46
Cysteine	0.45	0.46	0.65	0.58	0.62	0.46	0.37	0.44	0.54	0.50	0.43	0.49	0.49	0.46	0.60	0.61	0.63	0.42	0.80	0.57	0.52
Glutamic Acid	6.19	7.55	6.49	7.27	6.72	5.46	5.72	7.39	7.42	7.64	7.23	7.24	7.22	7.14	7.18	6.87	7.01	6.70	6.89	6.75	7.19
Glycine	6.45	6.01	6.76	5.74	6.85	6.39	6.93	5.85	5.74	5.96	6.21	6.30	6.23	6.26	4.66	4.81	4.72	6.78	7.03	5.43	5.77
Hydroxylysine	0.29	0.24	0.26	0.24	0.29	0.27	0.30	0.23	0.25	0.24	0.26	0.27	0.26	0.27	0.18	0.20	0.20	0.31	0.30	0.23	0.27
Hydroxyproline	2.52	1.97	2.62	1.94	2.57	2.61	2.83	2.07	2.04	2.25	2.25	2.35	2.30	2.26	1.37	1.48	1.42	2.57	2.46	1.80	1.94
Lanthionine	0.01	0.01	0.31	0.01	0.22	0.07	0.01	0.00	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.21	0.34	0.01	0.01
Ornithine	0.07	0.08	0.05	0.04	0.07	0.04	0.04	0.09	0.08	0.06	0.10	0.08	0.08	0.08	0.06	0.08	0.09	0.08	0.10	0.06	0.07
Proline	4.06	3.99	4.34	3.81	4.42	3.75	4.09	3.93	3.82	4.29	4.48	4.05	3.99	4.00	3.08	3.36	3.30	4.00	4.71	3.62	3.61
Serine	1.77	1.81	1.99	2.06	2.08	1.63	1.56	2.05	1.99	2.04	1.94	1.92	1.91	1.77	1.85	1.76	1.74	1.72	2.42	1.76	1.87
Taurine	0.08	0.13	0.07	0.06	0.07	0.06	0.05	0.09	0.10	0.08	0.10	0.12	0.11	0.10	0.12	0.12	0.13	0.09	0.08	0.12	0.10
Tyrosine	1.24	1.52	1.20	1.56	1.21	0.97	0.99	1.46	1.47	1.45	1.39	1.42	1.39	1.35	1.40	1.34	1.38	1.31	1.41	1.33	1.41
Total	49.7	56.6	51.1	55.4	54.0	44.4	46.5	55.5	55.3	56.0	55.4	55.6	55.2	54.4	49.1	48.4	49.3	52.3	56.5	50.9	53.7

Clemson Update

The U.S. Department of Energy (DOE) believes that biofuels—made from crops of native grasses, such as fast- growing *switchgrass*—could reduce the nation's dependence on foreign oil, cut back emissions of carbon dioxide, and strengthen America's farm economy.

The C4 grass switchgrass (*Panicum virgatum*) is a warm season grass and is one of the dominant species of the central North American tall grass prairie. According to a research group at the Clemson Environmental Genomics Laboratory (CEGL), switchgrass holds considerable promise as a biomass fuel in many agricultural regions in North America. Switchgrass has an energy output to input ratio of approximately 20:1, and typically can produce 175.5 MBtu of energy per 10 tons of biomass from land that is often of marginal crop producing value.

At CEGL, the group of scientists directed by Dr. Jeffrey Tomkins, has already developed a large-insert BAC library representing the switchgrass genome of a genotype that is considered the best in biomass productivity. Their project plans to develop an integrated genetic and genomic framework and use comparative genomics to facilitate gene discovery and pathways associated with biomass traits to enable bioenergy applications in crop improvement.

Noteworthy Article

Lammers PJ, Kerr BJ, Honeyman MS, Stalder K, Dozier WA 3rd, Weber TE, Kidd MT, Bregendahl K. (2008) Nitrogen-corrected apparent metabolizable energy value of crude glycerol for laying hens. Poultry Science 87(1):104-7.

An experiment was conducted with laying hens to determine the AME(n) value of crude glycerol, a coproduct of biodiesel production. Crude glycerol (87% glycerol, 9% water, 0.03% methanol, 1.26% Na, and 3,625 kcal/kg of gross energy) was obtained from a commercial biodiesel production facility (Ag Processing Inc., Sergeant Bluff, IA). A total of forty-eight 40-wk-old laying hens (Hy-Line W-36) were placed in metabolic cages (2 hens/ cage) and given free access to the experimental diets. A corn and soybean meal-based basal diet (18% CP, 2,875 kcal/kg of AME(n), 4.51% Ca, 0.51% nonphytate P) was formulated with 15% glucose.H(2)O and 1% Celite. Four dietary treatments were created by substituting 0, 5, 10, or 15% crude glycerol for glucose.H(2)O (3,640 kcal/kg of AME(n)). After 7 d of dietary adaptation, excreta were collected twice daily for 3 d, freeze-dried, and analyzed for contents of DM, Kjeldahl N, acid-insoluble ash, and gross energy. Egg production was recorded daily, and eggs were collected on d 7 and 8 of the experiment for calculation of egg mass (egg production x egg weight).

Feed consumption was measured over the 10-d experimental period. Egg-production data were analyzed by ANOVA with 4 treatments and 6 replications in a completely randomized experimental design. The AME(n) value of crude glycerol was estimated as the slope of the linear relationship between the inclusion rate of dietary crude glycerol and the glucose-corrected AME(n) value of the experimental diets. No significant treatment effects ($P > 0.1$) were apparent for egg-production rate (93.0%), egg weight (56.1 g), egg mass (52.2 g/d), or feed consumption (104 g/d).

Linear regression analysis ($P < 0.001$, r(2) = 0.92, n = 24) revealed that the AME(n) value of the crude glycerol used in this study was 3,805 +/- 238 kcal/kg (mean +/- SEM; as-is basis) for laying hens.

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